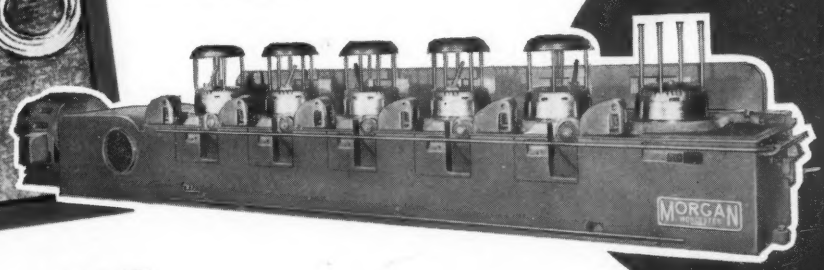
WIRE AND WIRE PRODUCTS

DECEMBER 1955

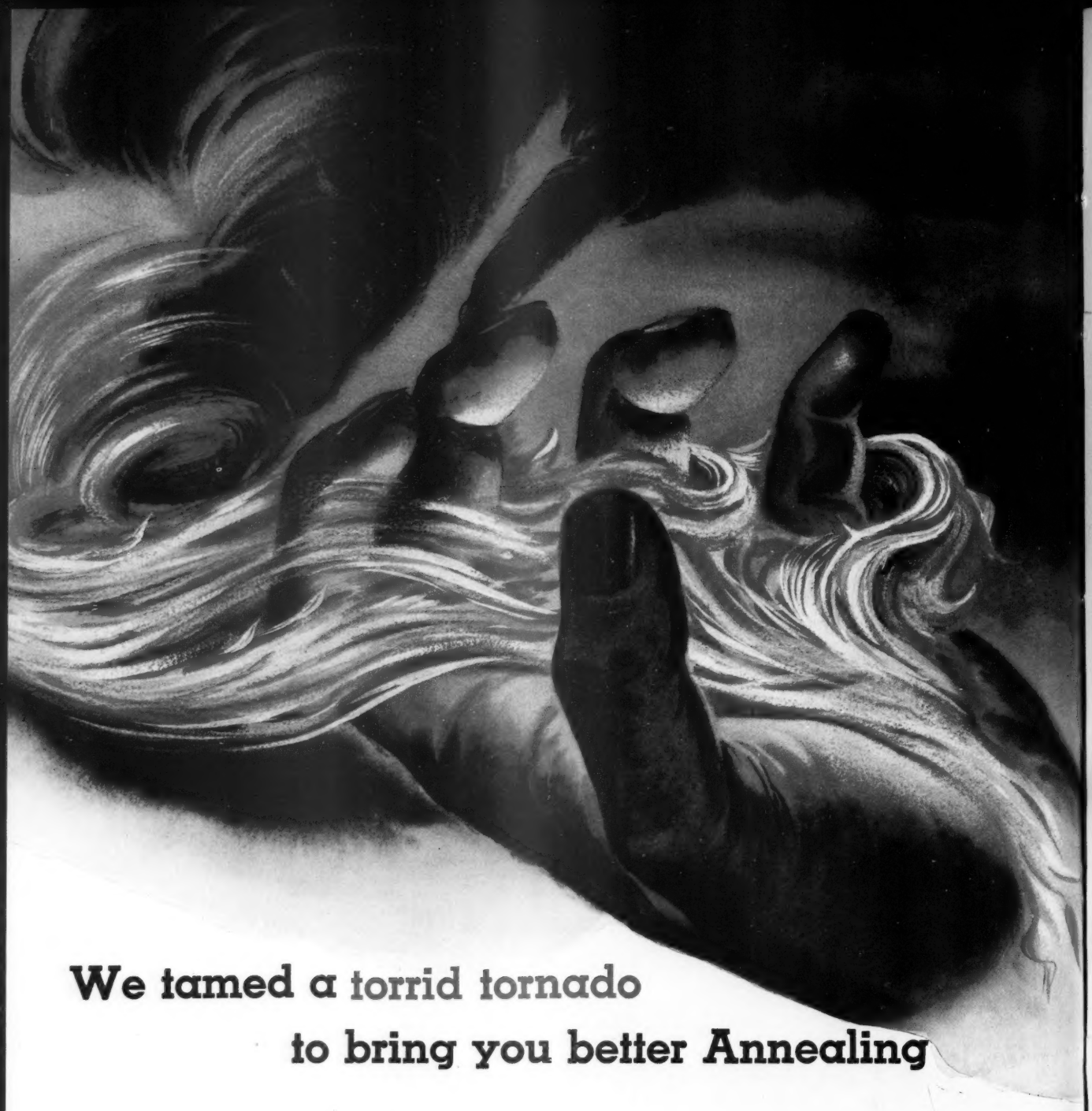
Coarse wire being reduced by hand, 1418. The equipment consists of a die, die holder, tongs and a swinging seat. The tongs are fastened to the man's belt, he applies his strength by pushing himself away with his feet.

TODAY, Morgan-Connor Wire Drawing Equipment represents the most modern advance in the field of wire production. Morgan-Connor's unique operating principal affords you higher production in less space at low power and die costs.

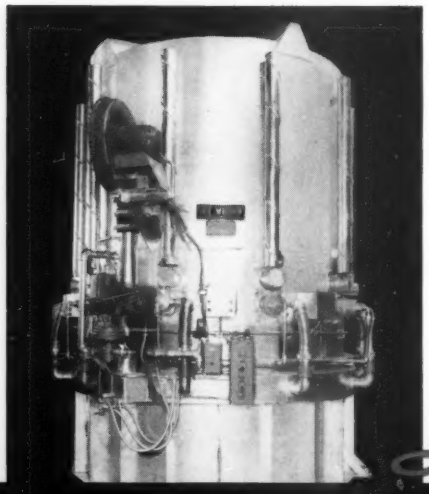


OLD-TIME GREETINGS FROM MORGAN WORCESTER

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION



We tamed a torrid tornado to bring you better Annealing



Torrid heats swirling at speeds of more than a mile a minute—
that's the **tornado type** heating that makes the new Lee Wilson
High Convection Wire Annealing Furnaces the fastest, most efficient
units of their kind available today.
They get to heat fast, completely saturating the entire charge with
an evenness that assures perfect uniformity of anneal.
The result of years of experience by the originators and leading
producers of radiant tube, single-stack annealing systems,
these new furnaces represent the most advanced wire and rod annealing
equipment marketed today.
Get all the facts and you'll get Lee Wilson!

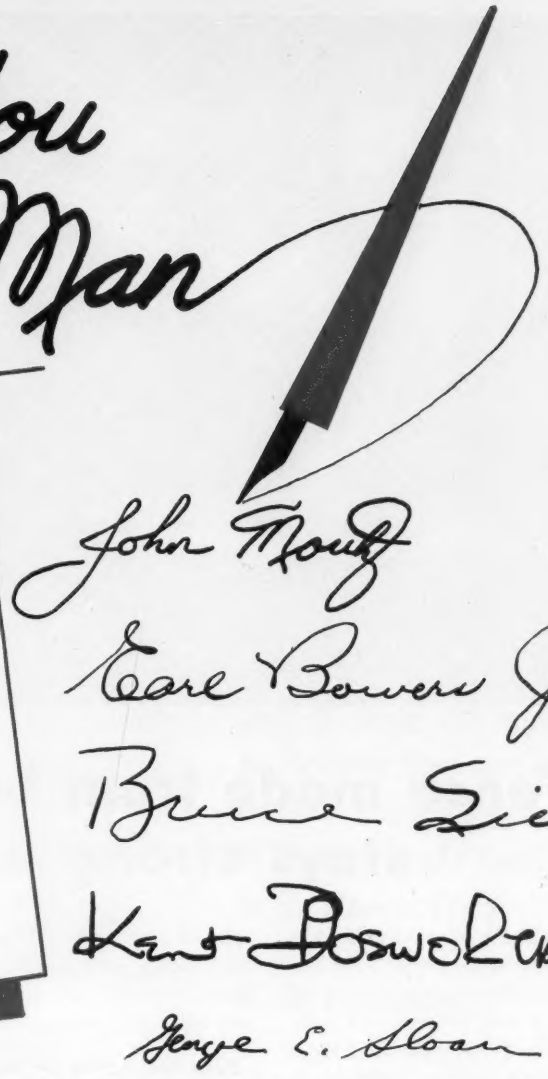
Lee Wilson ENGINEERING COMPANY • INC.

Thank You Mr. Wire Man

FOR YOUR
LOYALTY AND
COOPERATION IN
LEADING
STANDARD
TO THE GREATEST YEAR IN OUR HISTORY

•

OUR PLEDGE TO YOU IS CONTINUED LEADERSHIP IN SERVICE — PERFORMANCE AND RESEARCH



"Merry Christmas and Happy New Year to You and Yours"

Standard Industrial **COMPOUNDS CO., INC.**
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TELEPHONES: Mansfield 6-9324-5-6

Fence made from bethanized wire stays strong and bright

Much of the chain-link fencing is made today from bethanized wire — and for good reasons. The uniform coating of 99-pct-pure zinc protects the wire against corrosion long after other types of fence have become unsightly or rusted away. Bethanized fence keeps its sparkle through years of service because of the tight bond of pure zinc on steel. Fence erectors like bethanized fence because the wires are not rough and won't slash fingers.

Pure zinc, tightly bonded to steel . . . that's bethanized wire

There are no thin spots in the bethanized zinc armor to give rust a foothold. The electrolytic process deposits a coating that is uniform over every inch of the wire.

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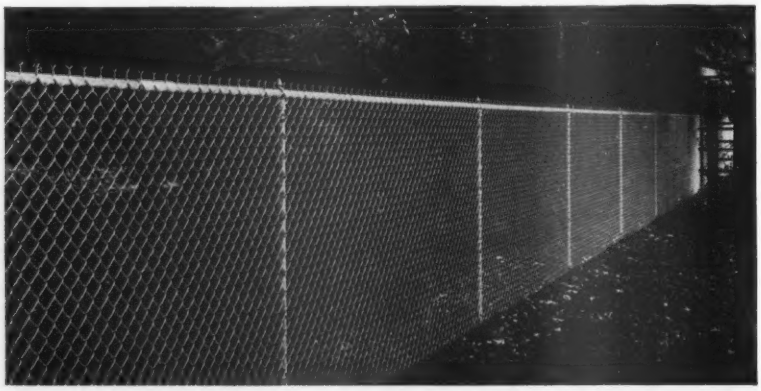
Whether you need hard or soft-temper wire, light or heavy zinc coatings, we will be glad to ship you a trial order of bethanized. Just phone or write our nearest sales office for full details.



The bethanized coating of pure zinc adds extra years of service to chain-link fence. Photo courtesy: Atlas Fence Co., Philadelphia, Pa.

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BETHLEHEM STEEL

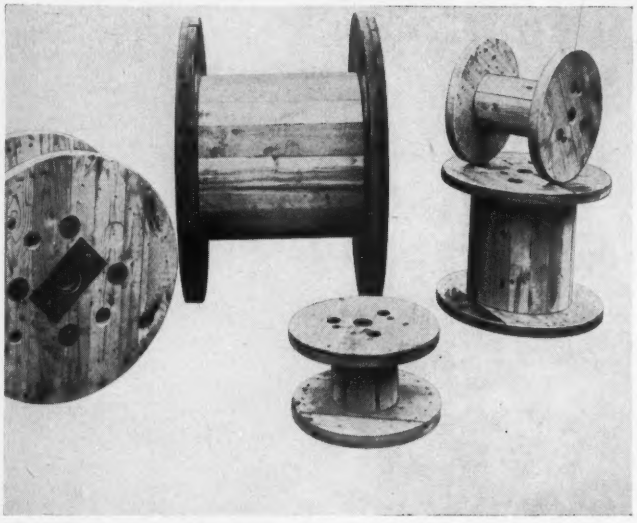
BETHLEHEM STEEL

SAVE with..

NON-RETURNABLE

WOOD shipping REELS...

for all sizes and types of Electric Wire and Cable



Look at these advantages:

- *Reduced Reel Investment*
- *Less Storage Space*
- *Lower Freight Costs*
- *No Repair Costs*
- *No Return Freight Costs*
- *No Bookkeeping*
- *No Cash Deposits Req'd.*
- *No More Headaches ! !*

NON-RETURNABLE REELS ALLOW DEFINITE PACKAGING COSTS.

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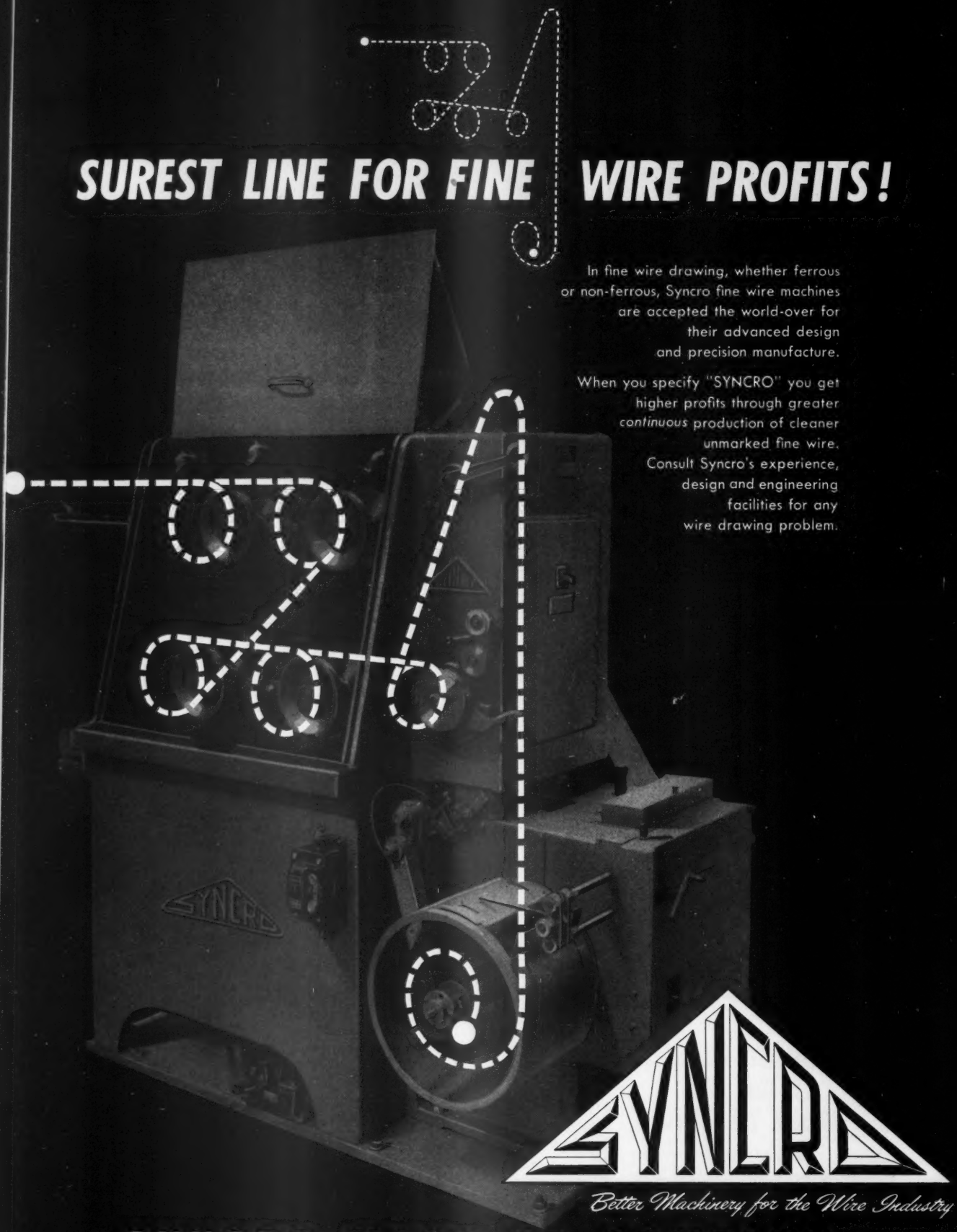
Let us quote on your reel needs. Send your specifications. Better yet, visit our plant and see how and why our reels are made so well at so low a cost.

WOOD REELS"

SUREST LINE FOR FINE WIRE PROFITS!



In fine wire drawing, whether ferrous or non-ferrous, Syncro fine wire machines are accepted the world-over for their advanced design and precision manufacture.

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WIRE AND WIRE PRODUCTS*

Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 30 December, 1955 No. 12

Designated as Official Publication By The Wire Association

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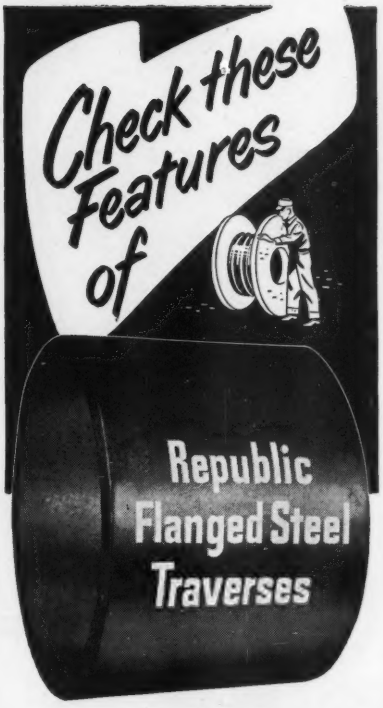

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CV Type Sparker
For Continuous Vulcanizing
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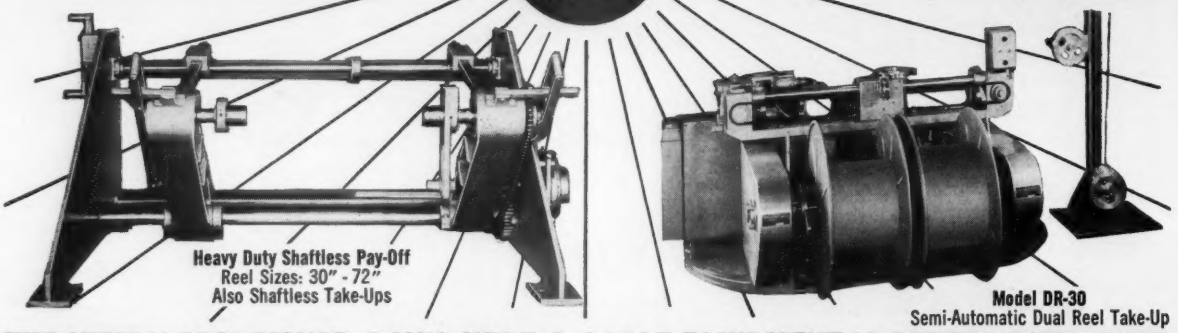

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What better tribute to quality can one ask?

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Davis ELECTRIC CO.

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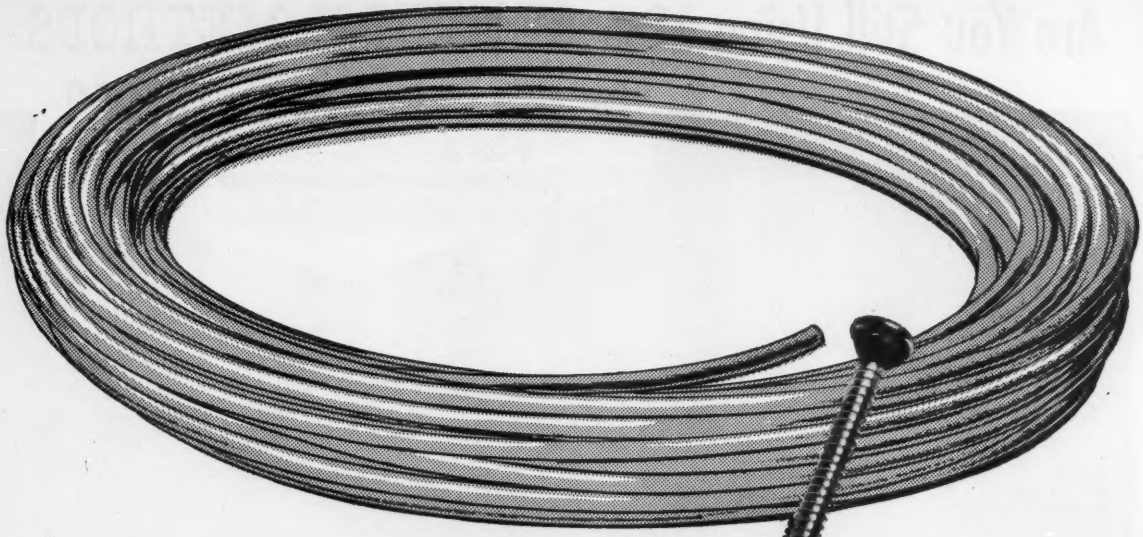

they grip tight...seal tight
—they're made of

CRUCIBLE
stainless steel cold heading wire

These *Tuff-Tite** fasteners, made by Townsend Company, New Brighton, Pa., have a neoprene washer preassembled into the head. They stop leaks... hold tight even where there's severe vibration... seal out moisture effectively.

Of course high speed production of these fasteners, like other types of screws, bolts, rivets and pins, demands cold heading wire with optimum workability. That means wire that's structurally sound and metallurgically uniform... with sufficient ductility to make forming easy... and with good tensile strength.

Crucible stainless steel cold heading wire has all these qualities — *plus* exceptional corrosion-resistance. That's why Crucible Types 305 and 410 stainless are used for the new *Tuff-Tite* fasteners, as well as for many other types of fasteners.

Crucible will fill your stainless cold heading wire needs quickly and efficiently... in the grade and size that best fits your application. Talk over your production requirements with your Crucible representative soon. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

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CRUCIBLE first name in special purpose steels

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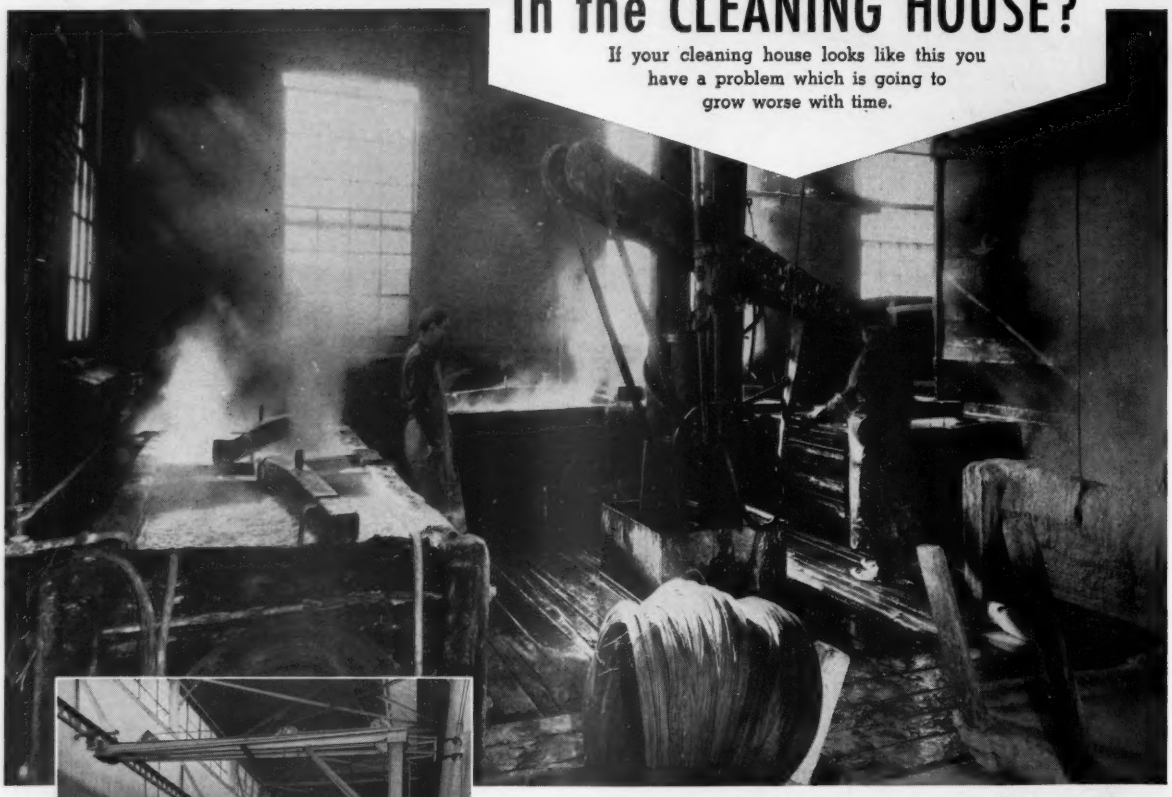
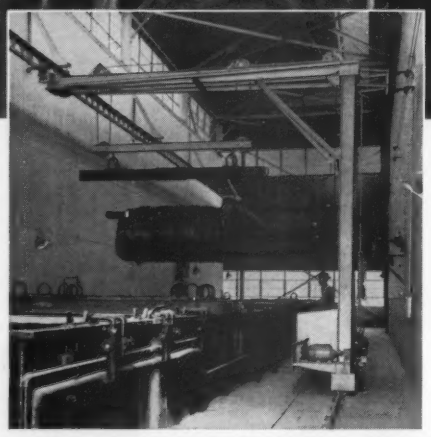
Are You Still Using 19th CENTURY METHODS In the CLEANING HOUSE?

If your cleaning house looks like this you have a problem which is going to grow worse with time.





It might surprise you, but when you clearly analyze it, you may discover that you actually are paying for a modern arrangement like this without having it. That is because of the great savings a modern cleaning house equipped with a Cleveland Tramrail gantry crane provides over the old jib-crane layout.

IF YOU are still working with the old revolving jib crane in your cleaning house, it is high time that you modernize. In this day and age you cannot continue to successfully meet competition with slow cumbersome old-fashioned methods.

As these pictures so realistically demonstrate, the differences between cleaning houses of yester-year and modern Cleveland Tramrail equipped ones is like that between night and day. From every standpoint: production costs, volume of output, cleanliness, orderliness, working conditions, the modern cleaning house is greatly superior.

Most cleaning houses today are modernized. You cannot afford to buck the trend. Cleveland Tramrail has had a tremendous amount of experience in this field and will be glad to work with you. Why not let our local sales engineer go into your problem without obligation.

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. . . IF IT'S A HIGH PRODUCTION PROBLEM . . .

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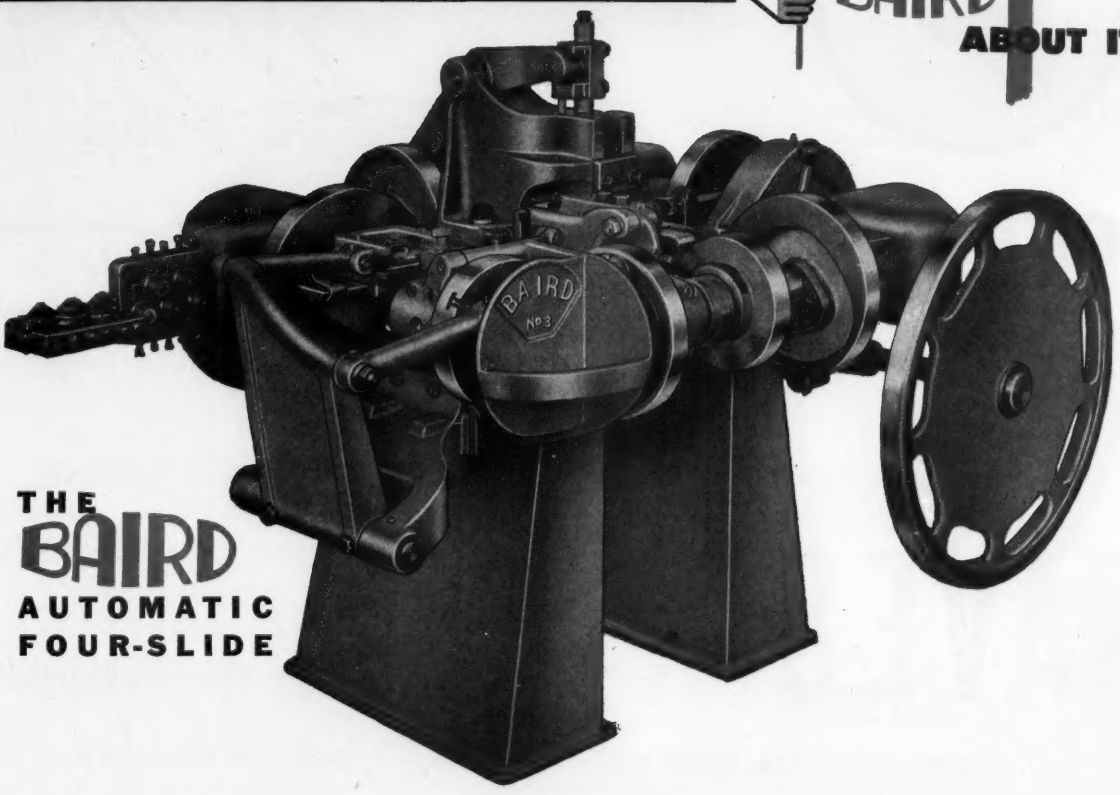

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NO MACHINE IN THE WORLD CAN MAKE A GREATER VARIETY OF PARTS . . . *OR PRODUCE THEM ANY FASTER*

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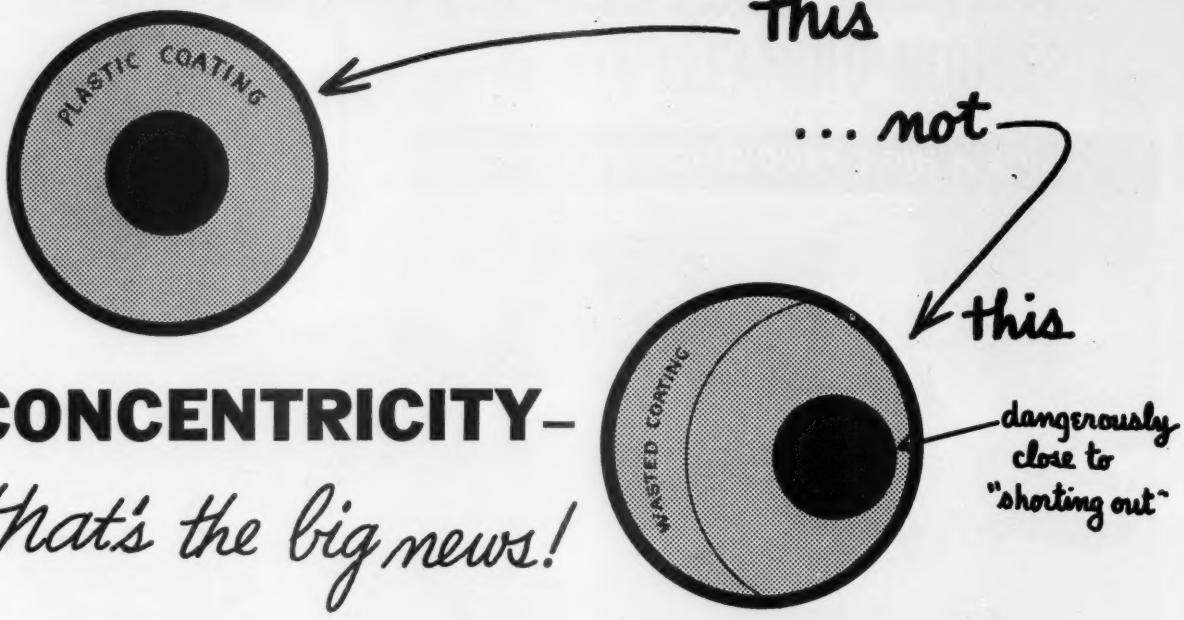

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last twice as long... yet cost no more!

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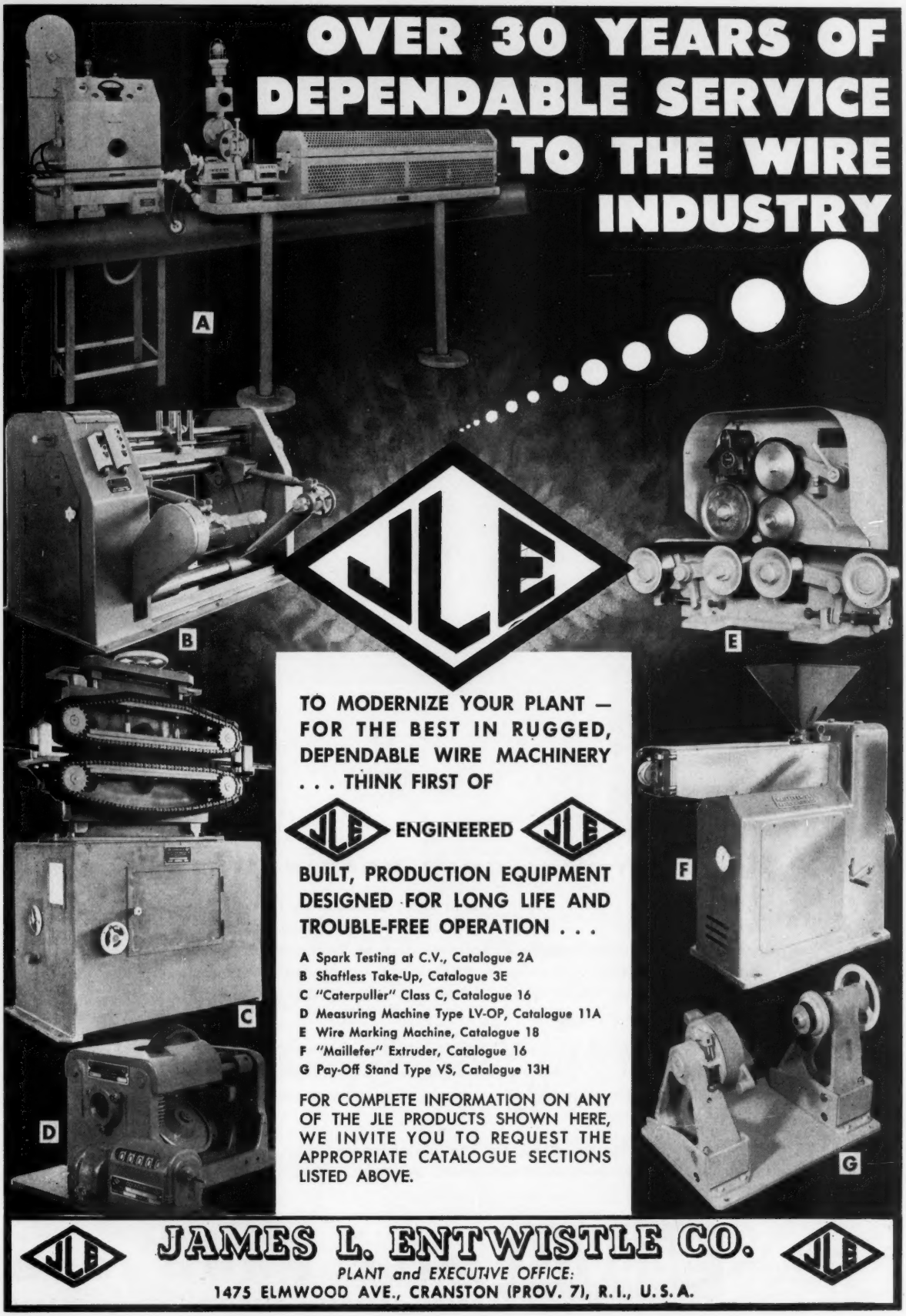

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F "Maillefer" Extruder, Catalogue 16
G Pay-Off Stand Type VS, Catalogue 13H

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Let us help you specify the proper closely controlled Scovill temper to produce more nearly perfect headed parts . . . whether you require "flow" characteristics for heading, or "flow" plus essential rigidity for secondary machining.

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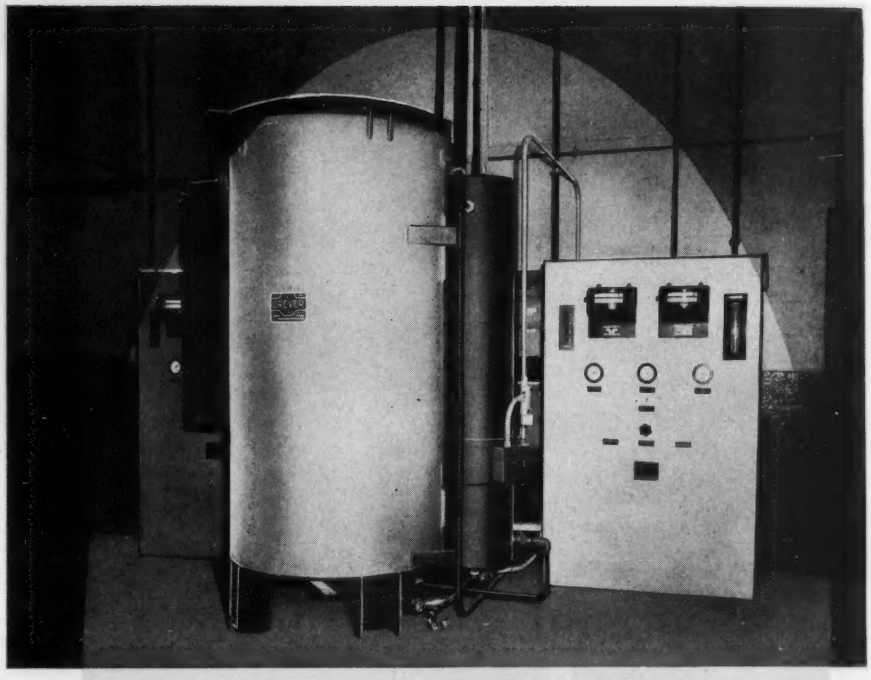

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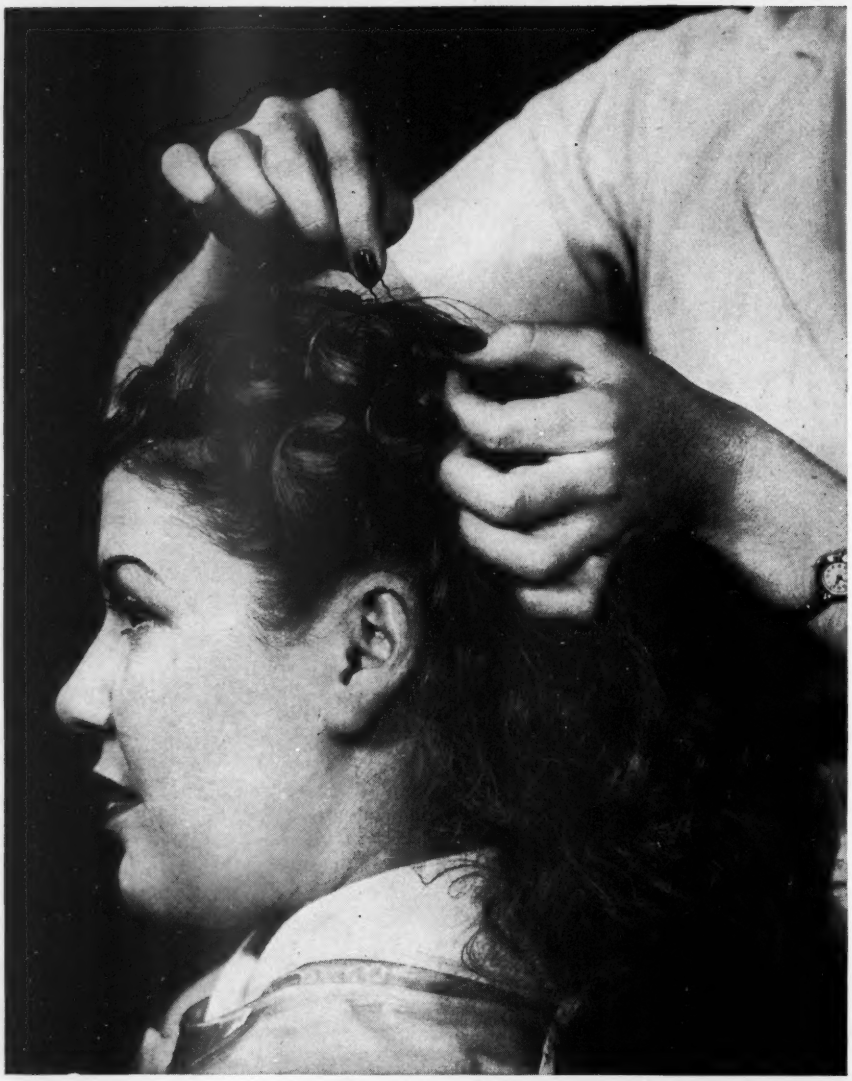
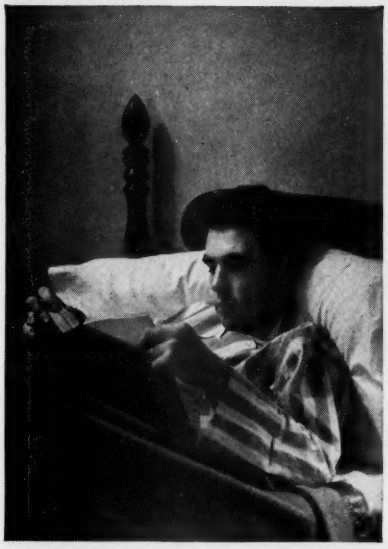
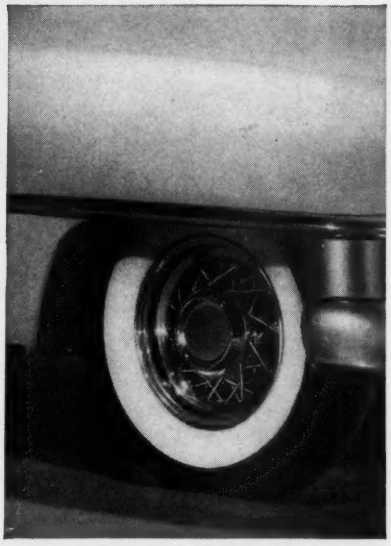


BEAUTY TIPS. Tons of wire are used by beauty shops in the form of bobby pins, hairpins and curlers. CF&I-Wickwire Hairpin Wire is used for these and many other mass-produced cosmetic items.

FOR THOUSANDS OF USES



"SPRING TIME" COMFORT. Coil bedsprings, mattress inner springs and mattress edge reinforcing are all made of CF&I-Wickwire Spring Wire in several tempers and hardnesses.



ROLLING ON WIRE. Strong, rigid spokes for automobile wheels are made of CF&I-Wickwire Spoke Wire.

MAKING BOOK. This eager young student's notebooks and textbooks are bound with CF&I-Wickwire Bookbinder Wire and Spiral Binding Wire.

from holding a plane on its course, to keeping a curl in place... wire is the practical answer!

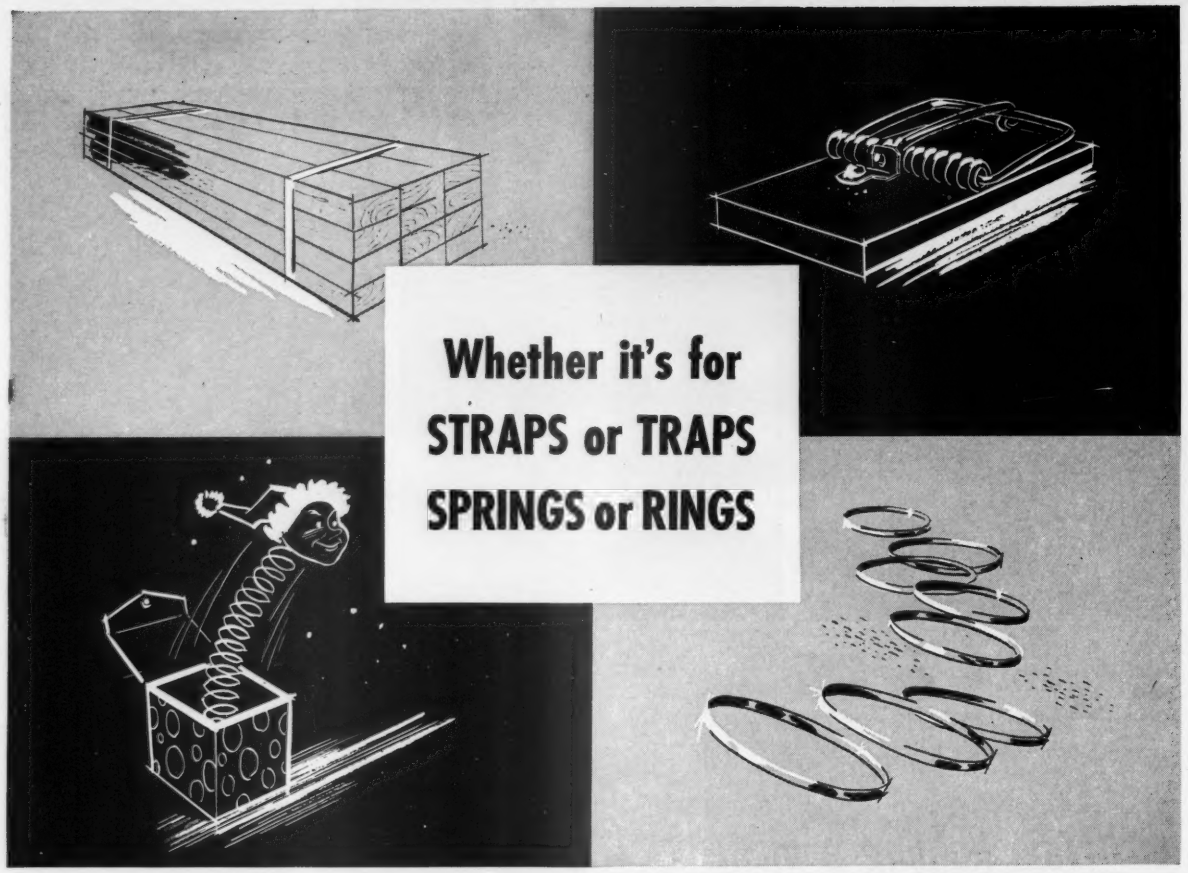
Wire can answer an almost incredible variety of needs because it can be varied to provide thousands of different combinations of mechanical and physical properties. From wire that can be easily twisted by hand to a rigid, self-supporting wire, it can be "tailor-made" to meet almost any set of requirements. Whatever you assemble, manufacture, or process, look into the many advantages of using CF&I-Wickwire Wire. You'll like doing business with CF&I-WICKWIRE and the careful attention given your own particular requirements.

CF&I-Wickwire Wire is made in plants conveniently located from coast to coast. For detailed information, write our nearest district sales office.

3145

CF&I—WICKWIRE WIRE

THE COLORADO FUEL AND IRON CORPORATION—Albuquerque • Amarillo • Billings • Boise • Butte • Denver
El Paso • Ft. Worth • Houston • Lincoln (Neb.) • Oklahoma City • Phoenix • Pueblo • Salt Lake City • Wichita
PACIFIC COAST DIVISION—Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane
WICKWIRE SPENCER STEEL DIVISION—Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia



SWIFT'S SOAPS are the efficient lubricants for wire drawing

Strategic distribution points throughout the U. S. and Canada can provide prompt, courteous service and immediate delivery on these versatile soaps:

SNAP. Heavy duty wire drawing powder. A neutral 96% soap affords consistently high titer range of 46 to 47° C. For use where exceptionally high temperatures prevail.

NO. 559 POWDER. In solution, will tend to remain fluid and completely free flowing at cool temperatures to afford top protection for wet drawing the finest wire products.

WHITE RIBBON (TALLOW) SOAP. For use at high temperatures where a low moisture, high soap content is desired.

Whether it's used to strap lumber or spring traps, all wire has this in common: speed is profit, but with the efficiency of speed comes the dangers of heat and friction. A compromise with the quality of your wire drawing lubricant at today's pace is a *certain* compromise with the efficiency you purchased in high speed equipment.

Swift's wire drawing lubricants are *efficient* because they are produced from *first choice* raw materials—to standards established through 50 years of serving specific wire drawing needs.

Why not let your Swift's man show you how our expanding line of soaps can help *you* make the most of speed . . . the *least* of heat and stress? Call him today and remember . . .

ONE TRIAL IS BETTER THAN A THOUSAND CLAIMS

Swift
1855 CENTENNIAL 1955
TO SERVE YOUR INDUSTRY BETTER

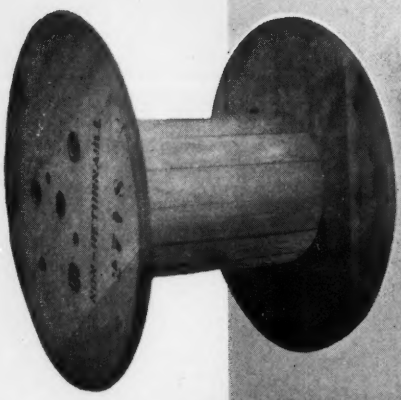
SWIFT & COMPANY

SOAP DEPARTMENT

4115 PACKERS AVENUE • CHICAGO 9, ILLINOIS

SAVE your company more!!!

SERVE your customers better!!!



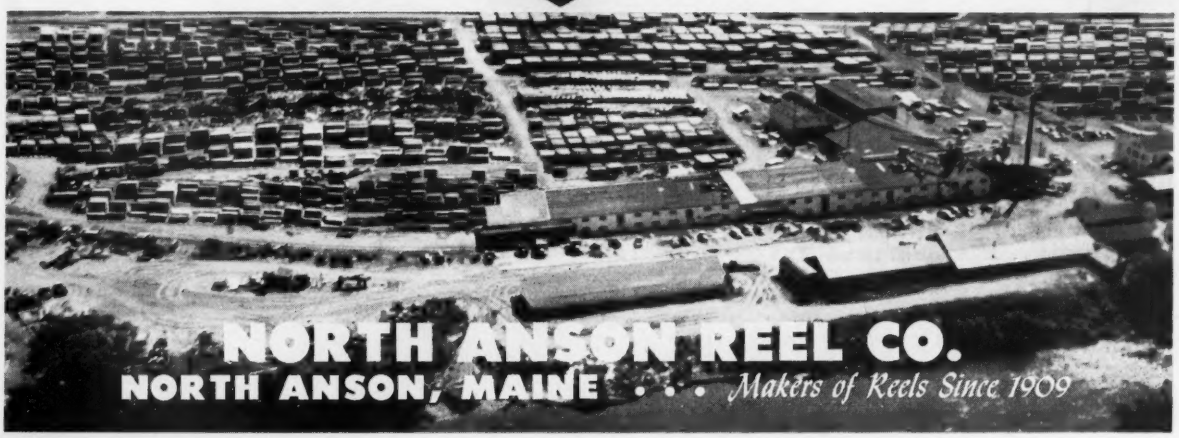
the NARCO
NON-RETURNABLE

An expendable package — light in weight, soundly engineered and **LOW IN COST.** Save costly freight, expensive reel maintenance, valuable plant space. Serve without the inconvenience and expense of deposits to yourself **and** your customer.

the NARCO
METAL BOUND

A returnable package — lasts **FOUR TO SIX TIMES** as long as all wood reels. For applications where a non-returnable cannot be used. This durable reel requires no maintenance and is lighter than comparable all wood reels. Superior service and satisfied customers.

Remember — THESE ARE PRODUCTS OF THE MOST MODERN UP-TO-DATE REEL PLANT IN THE WORLD (MANUFACTURED BY A COMPANY WITH NEARLY 50 YEARS EXPERIENCE); A BACKGROUND OF EXHAUSTIVE TESTING AND RESEARCH IN THE LABORATORY AND THE FIELD.



NORTH ANSON REEL CO.
NORTH ANSON, MAINE . . . *Makers of Reels Since 1909*

SCHUMAG AACHEN

THE FOUR-IN-ONE CONTINUOUS BAR and ROD MAKING MACHINES

FROM A ROUGH COIL OF WIRE
TO STRAIGHTENED AND POLISHED BARS or RODS
BARS or RODS
Round, Square, Hexagon, Rectangular, Special Shapes
TUBING

Hundreds of "SCHUMAG" Continuous Bar or Rod Making Machines are today in most satisfactory operation in all industrial countries

Exclusive Representatives for USA, Canada & Mexico

AMERICAN LAUBSCHER CORPORATION
Fisk Bldg., 250 West 57th Street, New York 19, N. Y.

DIAMOND POWDER
RECLAIMING SERVICE

ACCURATELY GRADED AND GUARANTEED

RECLAIMING

1. Send us your diamond-bearing waste. Our reclaiming department will salvage the diamond powders from wheels, sludges, hones, saw blades, cotton wastes or any type of diamond-bearing materials for you at reasonable prices.

2. These are cleaned, graded and returned to you for re-use—or, if you prefer, bought outright from you on the basis of the amount of diamond powder reclaimed. Your preference guides us.

RECLAIMED AND VIRGIN POWDER SALES

3. The sales department has available from stock a full range of micron sizes, reclaimed or virgin, that are sold to you on a money-back basis as a guarantee of their accuracy of grading and quality.

4. Free samples are offered for your inspection in any size or sizes desired. These sizes range from 0-2, 1-5, 4-8, 6-10, 10-20, 20-40, and 30-60 microns, plus 400 and 325 mesh.

5. The service rendered to you by these two departments makes for an efficient and agreeable relationship between you and our factory. Your complete satisfaction with our products and service is assured.

We invite your inquiries

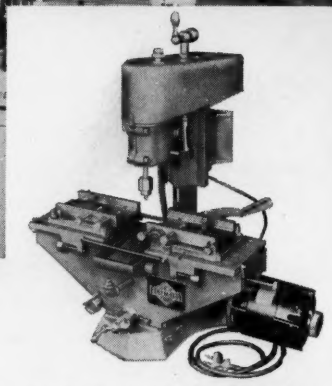
KAY & WARREN COMPANY

33 BOX STREET • BROOKLYN 22, N. Y.

Reclaimers of

INDUSTRIAL DIAMONDS and DIAMOND POWDERS

This DIE room paid for itself!



Firth Sterling Nail Die Barbing Machine

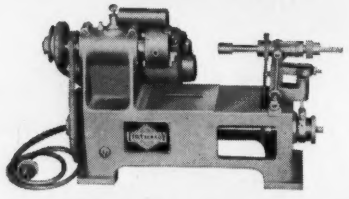
Firth Sterling can plan and equip one for you, too . . .

A well designed, well equipped and well organized die room soon pays for itself in savings resulting from longer die life, reduced downtime, smaller investment in die inventory and greater uniformity and quality of product resulting from precision tooling.

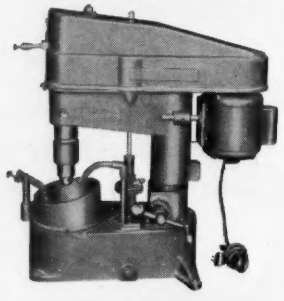
Firth Sterling, long a leader in the field with Firthaloy Dies, knows best die room practices as no other . . . and offers to the wire industry a complete die room planning and engineering service *right down to the machines to equip it.*

Firth Sterling tungsten carbide die finishing equipment is available from stock for complete tool room set-ups or as individual machines, according to your need.

Don't let an inadequate die room cost you money. Start the installation of a *modern* one by calling a Firth Sterling planning engineer. Do it now!



Firth Sterling Automatic Polisher



Firth Sterling Heavy Duty Ripper

R-315

Firth Sterling

—INC—

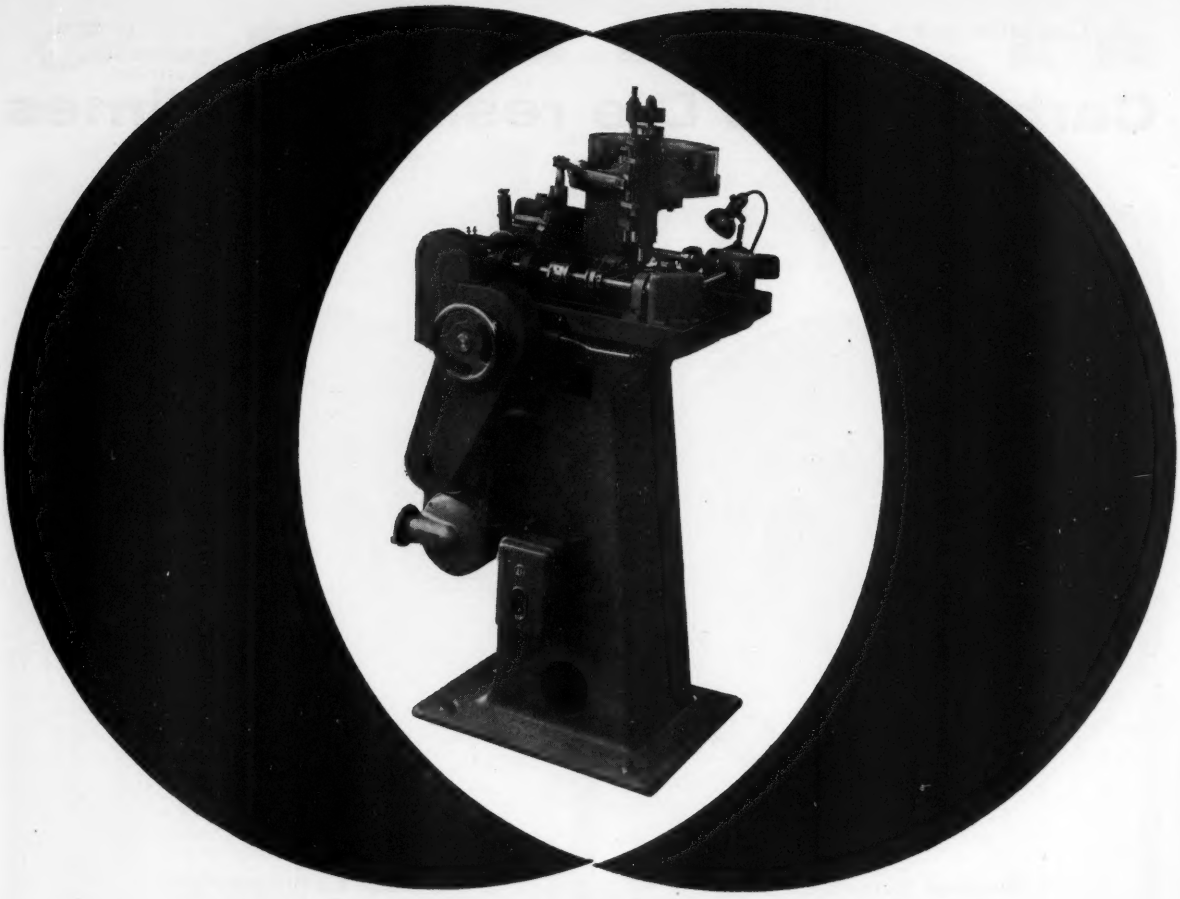
GENERAL OFFICES: 3113 FORBES ST., PITTSBURGH 30, PA.

MILLS: McKEESPORT, TRAFFORD, DETROIT, HOUSTON

OFFICES AND WAREHOUSES*: BIRMINGHAM CHICAGO* CLEVELAND DAYTON DETROIT* HARTFORD* HOUSTON LOS ANGELES* NEW YORK PHILADELPHIA PITTSBURGH WASHINGTON WESTFIELD, N.J.

PRODUCTS OF FIRTH STERLING METALLURGY

High Speed Steels
Tool & Die Steels
Stainless Specialties
High Temperature Alloys
Zirconium
Sintered Tungsten Carbides
Firth Heavy Metal
Chromium Carbides
High Temperature Cermets



the new Torrington W3000

...latest addition to Torrington's growing line of torsion spring winders

The W3000 torsion winder is a modern, high production machine with the largest tooling area devised for a machine of its size. Tooling can be simpler and sturdier. Shafts on three sides of the work area permit the use of individual horizontal slides. These, in conjunction with a rugged vertical two-slide, give Torrington's torsion winder unprecedented versatility and flexibility. Many springs which have previously required secondary operations can now be made complete on this torsion winder.

The W3001 torsion winder, companion of the W3000, is identical in advantages and larger in capacity.

Torrington designs, builds and *services* more springmaking machines for the professional springmaker than all other manufacturers combined. Call on Torrington for equipment best fitted to your needs . . . and depend on Torrington for fast expert assistance on springmaking problems.

Normal Rated Capacity:
Up to 10 turns of spindle for .041" wire
Up to 24 turns of spindle for .028" wire
Up to 40 turns of spindle for .020" wire

Production:
25 to 150 springs per minute

Wire Feed:
Short slide feed — 2½"
Long slide feed — 4½"

Maximum O.D. Coil:
¾"

Maximum Spindle Travel:
2"

Horizontal Slide Travel:
¾"

Vertical Slide Travel:
⅝"

Cam Shaft Diameter:
¾"

Height of Wire Line:
44"

Floor Space:
26" x 30"

Net Weight:
1,000 lbs.

Electrical:
½ h.p. wired for either 220 or 440 volts, 3 phase, 60 cycle, A.C. Manual starter included.

Standard Equipment:
Light, counter, cutter quill blank, cutter quill stand, arbor adapter blank.

THE
TORRINGTON
MANUFACTURING COMPANY
TORRINGTON · CONNECTICUT

Carbide wire-die user reports . . .

Carboloy R-3 Die resized 20 times

Original Carboloy R-3 Die with .025″ starting hole. Normal maximum is .182″.

Carboloy R-3 Die after 20 resizes. Final hole is .236″ – 30% larger than normal maximum.

STARTING hole size on the Carboloy R-3 Wire Die, above, is .025″; the normal maximum is .182″. But our Carboloy customer successfully reground the R-3 to .236″ . . . 30% over maximum. Even after the twentieth resize, his wire had the same high quality and precision finish.

Longer die life and superior performance, due to Carboloy built-in quality, are but two of the money-saving "bonus" benefits you get – at no extra cost – with every Carboloy® cemented carbide Wire Die.

Others include: Immediate local delivery, in-plant engineering assistance, die servicing and finishing facilities, technical literature, and die training school for your personnel. Call in an expert Carboloy Wire Die Engineer, today. Or, write for Carboloy Die Catalog and Service Manual.

"Carboloy" is the trademark for products of the Carboloy Department of General Electric Company

CARBOLOY

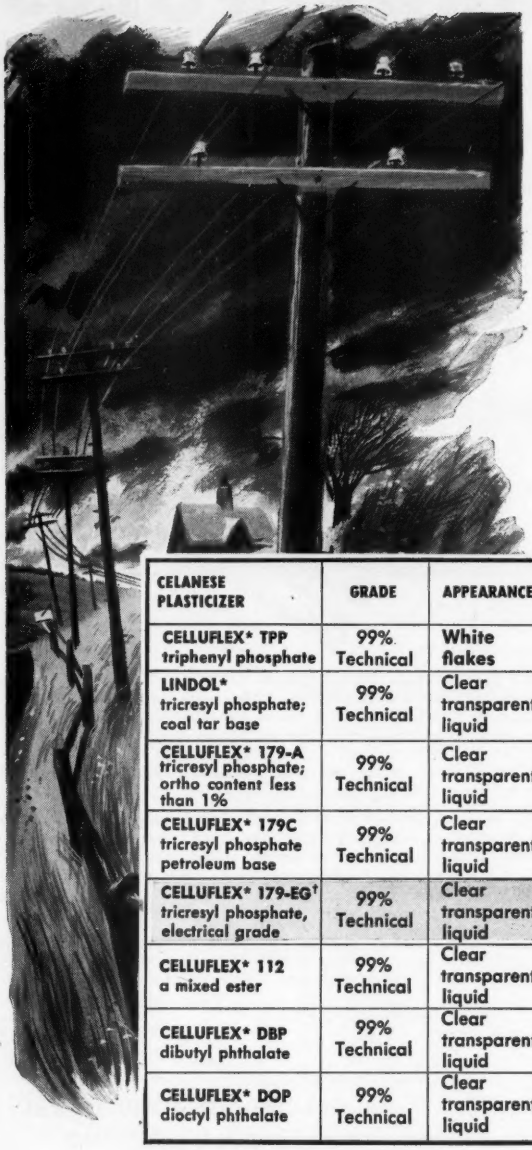
DEPARTMENT OF GENERAL ELECTRIC COMPANY

11171 E. 8 Mile Street, Detroit 32, Michigan

Carboloy Created-Metals for Industrial Progress

Celanese CHEMICALS

PLASTICIZER



RECOMMENDED

CELLUFLEX* 179 EG

FOR

WIRE INSULATION

WHY

WEATHER RESISTANCE

DESCRIPTIVE DATA

CELANESE PLASTICIZER	GRADE	APPEARANCE	COLOR APHA Max.	SPECIFIC GRAVITY @20/20° C.	ACIDITY	ESTER VALUE % Min.	PERMANGANATE TIME, Min. (In Minutes)	WATER CONTENT % Max. by Wt.
CELLUFLEX* TPP triphenyl phosphate	99% Technical	White flakes	20 (3)	1.221 (1)	0.03 (2)	99	30	0.1
LINDOL* tricresyl phosphate; coal tar base	99% Technical	Clear transparent liquid	50	1.167 ± .005	0.1 (2)	99	30	0.1
CELLUFLEX* 179-A tricresyl phosphate; ortho content less than 1%	99% Technical	Clear transparent liquid	100	1.143 ± .006	0.1 (2)	99	30	0.1
CELLUFLEX* 179C tricresyl phosphate petroleum base	99% Technical	Clear transparent liquid	100	1.165 ± .005	0.1 (2)	99	30	0.1
CELLUFLEX* 179-EG† tricresyl phosphate, electrical grade	99% Technical	Clear transparent liquid	100	1.143 ± .008	0.1 (2)	99	30	0.1
CELLUFLEX* 112 a mixed ester	99% Technical	Clear transparent liquid	40	1.200 ± .005	0.1 (2)	99	30	0.1
CELLUFLEX* DBP dibutyl phthalate	99% Technical	Clear transparent liquid	25	1.045 ± .001	0.1 (2)	99	—	0.1
CELLUFLEX* DOP dioctyl phthalate	99% Technical	Clear transparent liquid	25	0.985 ± .004	0.1 (2)	99	—	0.1

(1) @60/60° C. (2) Mg. KOH/gram sample (3) Molten †Volume Resistivity: 16 megohm/cm x 10^7 at 23° C. min.

Where weather and high volume resistivity are major considerations, Celluflex 179 EG is the specified plasticizer. 179 EG (electrical grade tricresyl phosphate) imparts excellent resistance to weathering and maintains high insulation value in vinyl wire and cable coverings.

Celanese is an expanding source of plasticizers for many jobs. Bulk stocks at convenient distribution points are ready to meet tight schedules. Combination shipments — Celanese Plasticizers and Solvents or Intermediates — yield an extra dividend in price differential and freight savings. Be on our mailing list for new plasticizer developments. Please drop a card to Dept. 590-L Celanese Corporation of America, Chemical Division, 180 Madison Avenue, New York 16, N.Y.

*Reg. U. S. Pat. Off.

Celanese CHEMICALS

ALL ROLLING MILLS NOW USE Talide WORK ROLLS

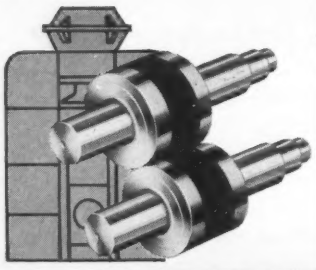
FOR EVERY TYPE FINISHING MILL

During the last five years Talide rolls have been adopted by every major strip steel producer. Metal Carbides pioneered and developed tungsten carbide rolls and successfully adapted them to all types of rolling mills including STECKEL, BLISS, UNITED, MESTA, STANAT, SENDZIMIR, WATERBURY-FARREL, TORRINGTON, RUESCH, FENN, WEAN, COLD METAL, etc.

Talide rolls have proven far superior to both steel rolls and carbide rolls of any other make.

168 to 7 hours

Leading Ohio strip steel producer averages 750 coils of various types and analyses between grinds, enabling them to operate their cold rolling mill continuously without roll changes for 7 days, 3 turns per day. Previous steel rolls used averaged 6-8 hours, necessitating 3 or 4 roll changes per day with considerable downtime.



210 to 5 days

Large Mid-Western producer of chrome-nickel alloy flat wire is averaging 7 months' continuous service between grinds compared to 5 days average run with steel rolls. Among other advantages, customer reports improved surface finish adds to sales appeal of finished product, fewer anneals are required to produce desired reduction, and wire runs cooler, resulting in less oxidation.

Talide work rolls are ultra-hard, extremely dense, and porous-free. Manufactured from highest purity tungsten carbide powders, the surface finish of a Talide roll is smoother than one micro-inch. Hard as a diamond, it will take a "bigger bite" than a steel roll. Strip steel of all analyses can be rolled down to thinner gauge, with more accuracy, greater reductions and with fewer anneals than possible with any other roll.

All users of Sendzimir rolling mills have adopted Talide work rolls because operating results have been phenomenal, far surpassing all expectations. The higher initial cost of Talide rolls is offset many times by the very substantial savings realized in less downtime, fewer regrinds, reduced scrap, reduced strain and stress load on back-up rolls, bearings and mill housings.

Tremendous production runs are commonplace with Talide rolls with mill after mill reporting increased tonnage-runs between roll changes of 278-1, 179-1, 82-1, etc. **Metal Carbides Corporation, Youngstown 7, Ohio.**

SPECIAL DIAMOND WHEEL for ROLL GRINDING

The Superset diamond grinding wheel was specially developed for grinding carbide rolls to highest possible surface finish and luster. Made of 4-8 micron size diamond dust, it imparts a surface finish far superior to any other commercial wheel. Available in sizes up to 25" diameter.

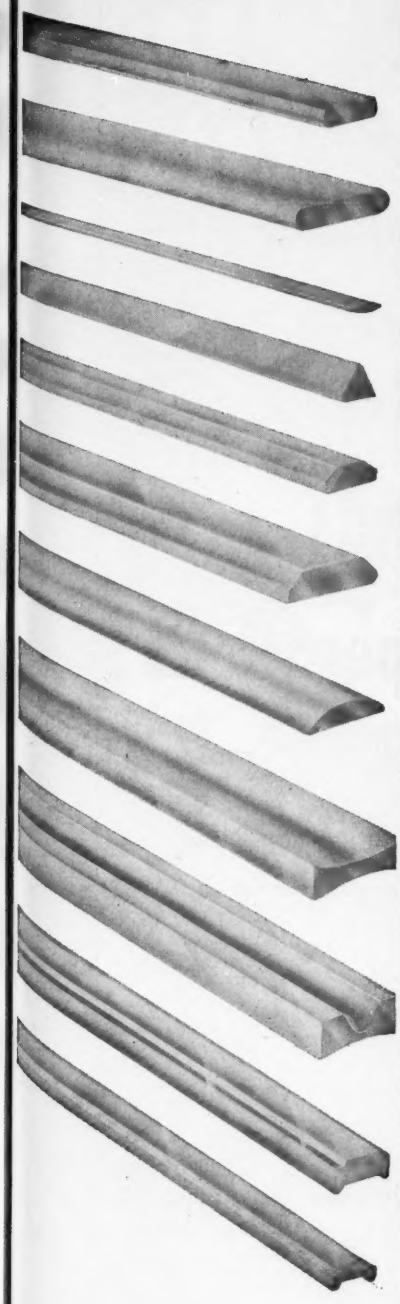
ROLL REPAIRING

Broken or damaged carbide rolls can be re-worked to first class condition with all defects eliminated at one-half original cost. Only Metal Carbides offers this service—because of its exclusive hot press method.

Send for new 84-page catalog 55-G

METAL CARBIDES CORPORATION
MC TALIDE®
YOUNGSTOWN 7, OHIO

HOT PRESSED AND SINTERED CARBIDES · VACUUM METALS
HEAVY METAL · CERMETS · HIGH TEMPERATURE ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY



NATIONAL WIRE

(COLD ROLLED)

in Coils or Straight Lengths

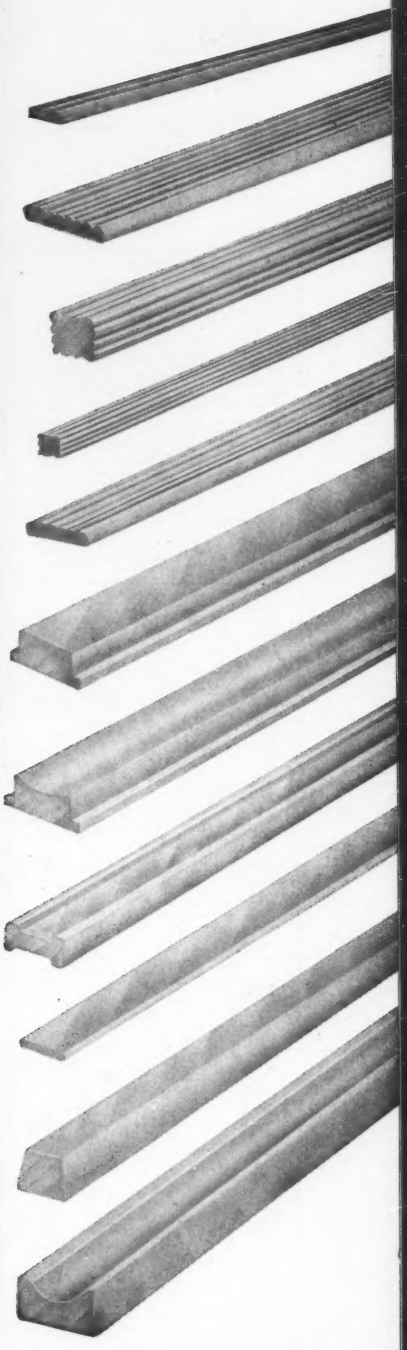
COMPLETE METALLURGICAL SERVICE

Manufacturers of

SPRING WASHERS	RETAINING RINGS
ROUND EDGE FLAT WIRE	KEYSTONE SHAPED WIRE
SQUARE EDGE FLAT WIRE	SPECIAL SHAPED WIRE

Shaped Wire in Coils or Straight Lengths, Ferrous or Non-Ferrous.

LARGE OR SMALL QUANTITIES



Manufactured by

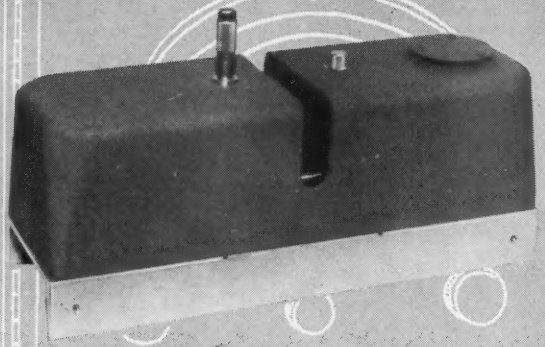
THE NATIONAL LOCK WASHER COMPANY

PRECISION SHAPED WIRE DIVISION

NEWARK 5, N. J. MILWAUKEE 2, WIS. U.S.A.

MODEL 309 MICROLIMIT CONTROL

FOR AUTOMATIC CONTROL OF INSULATED WIRE DIAMETER IN THE RANGE OF .025 TO .750 INCH



COMPLETELY ENGINEERED TO YOUR EXTRUDER

start savings in your insulating operations

- ***STARTING*** Save up to 50% of the compound and conductor usually lost in bringing the extruder up to speed — with *continuous gauging.*
- ***RUNNING*** Save several times the cost of the control annually by reducing nominal diameters — with *non-contact gauging.*
- ***LABOR*** Save manhours by relieving your operators for other essential work — with *automatic control.*

INDUSTRIAL GAUGES CORPORATION • WEST ENGLEWOOD, NEW JERSEY

finer dies faster for the wire industry with...

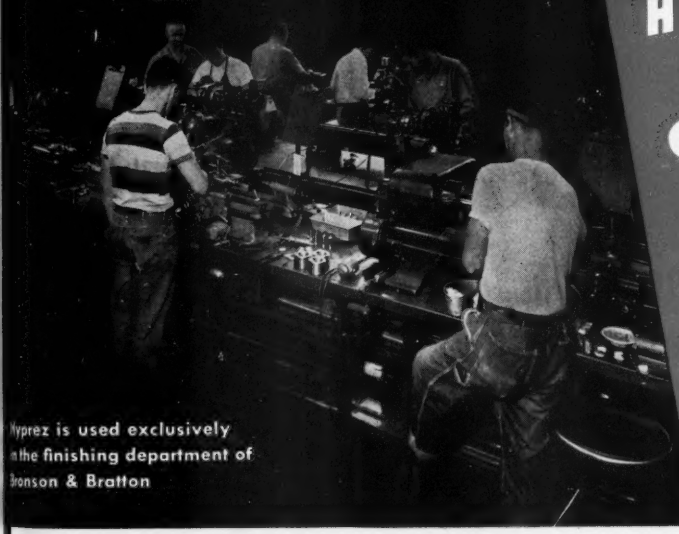
Hyprez used for flawless die finish at modern Chicago plant of Bronson & Bratton, a leading supplier of tungsten-carbide products for the wire industry

HYPREZ

High Precision DIAMOND COMPOUNDS

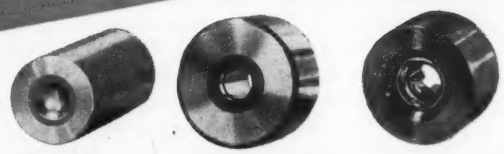
For economy of muscle, time and cost, Bronson & Bratton, Inc., Chicago, and scores of other die manufacturers and users, demand Hyprez, the original Diamond Compound.

Hyprez is engineered to highest standards of performance: diamond particles of exact grading and concentration; a vehicle assuring permanent suspension; integral color identification; maximum finishing action . . . A complete range of grades, from coarsest to finest.



Hyprez is used exclusively in the finishing department of Bronson & Bratton

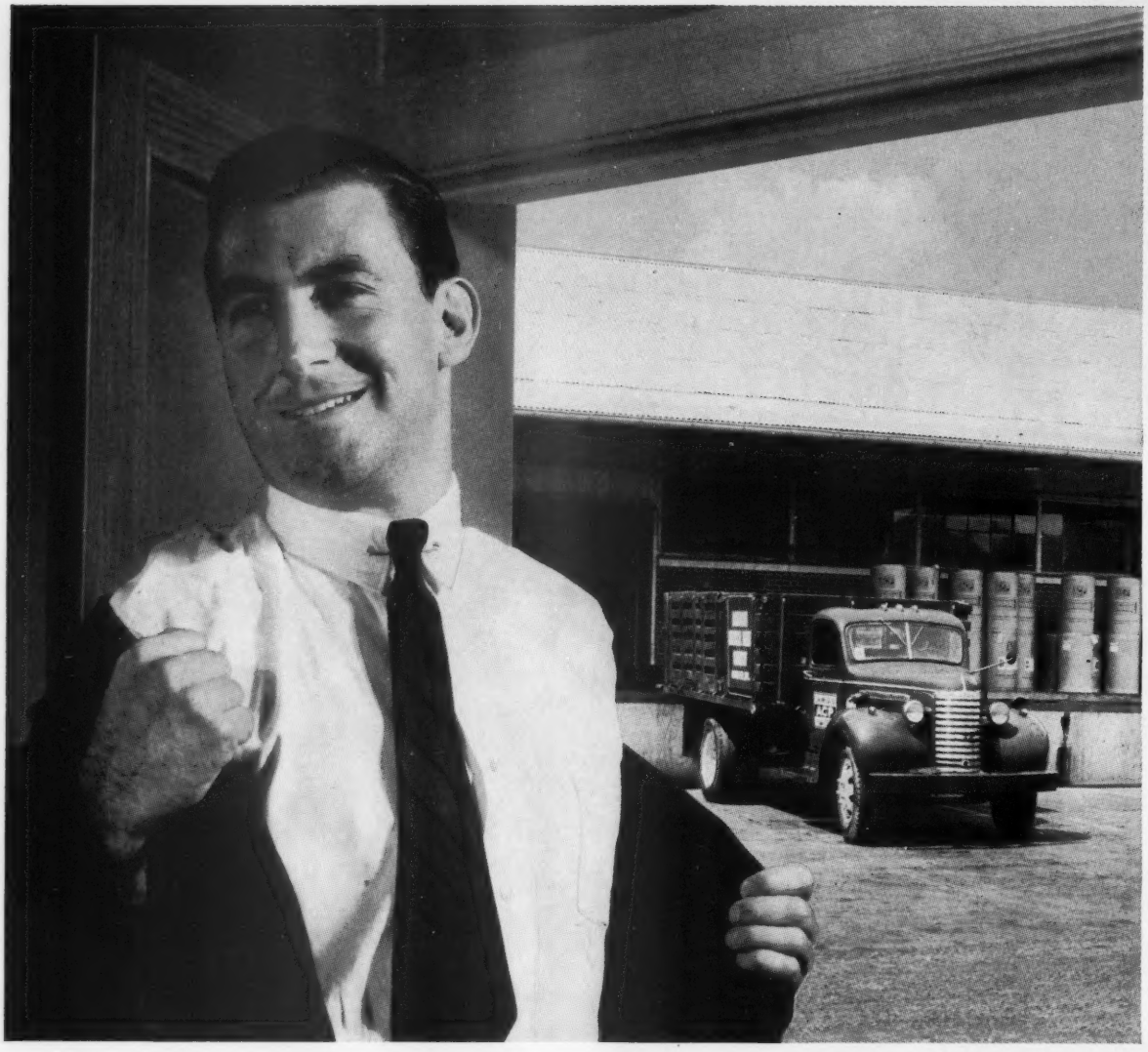
Ask for a free demonstration or technical bulletin No. W-125



HYPREZ DIVISION

ENGIS EQUIPMENT COMPANY, CHICAGO 5, ILL.

431 SOUTH DEARBORN ST.



WE DON'T STOP WITH THE DELIVERY OF A CHEMICAL—
we put it to work and keep it working effectively

The chemical treatment of metals and metal parts—to prepare them for further processing, to protect them, to beautify them—has grown from a haphazard operation to a highly technical one. Supplying the chemical ingredients is a relatively simple job. Putting them to work and keeping them working effectively in your plant demands the skill of an experienced organization. We have that organization.

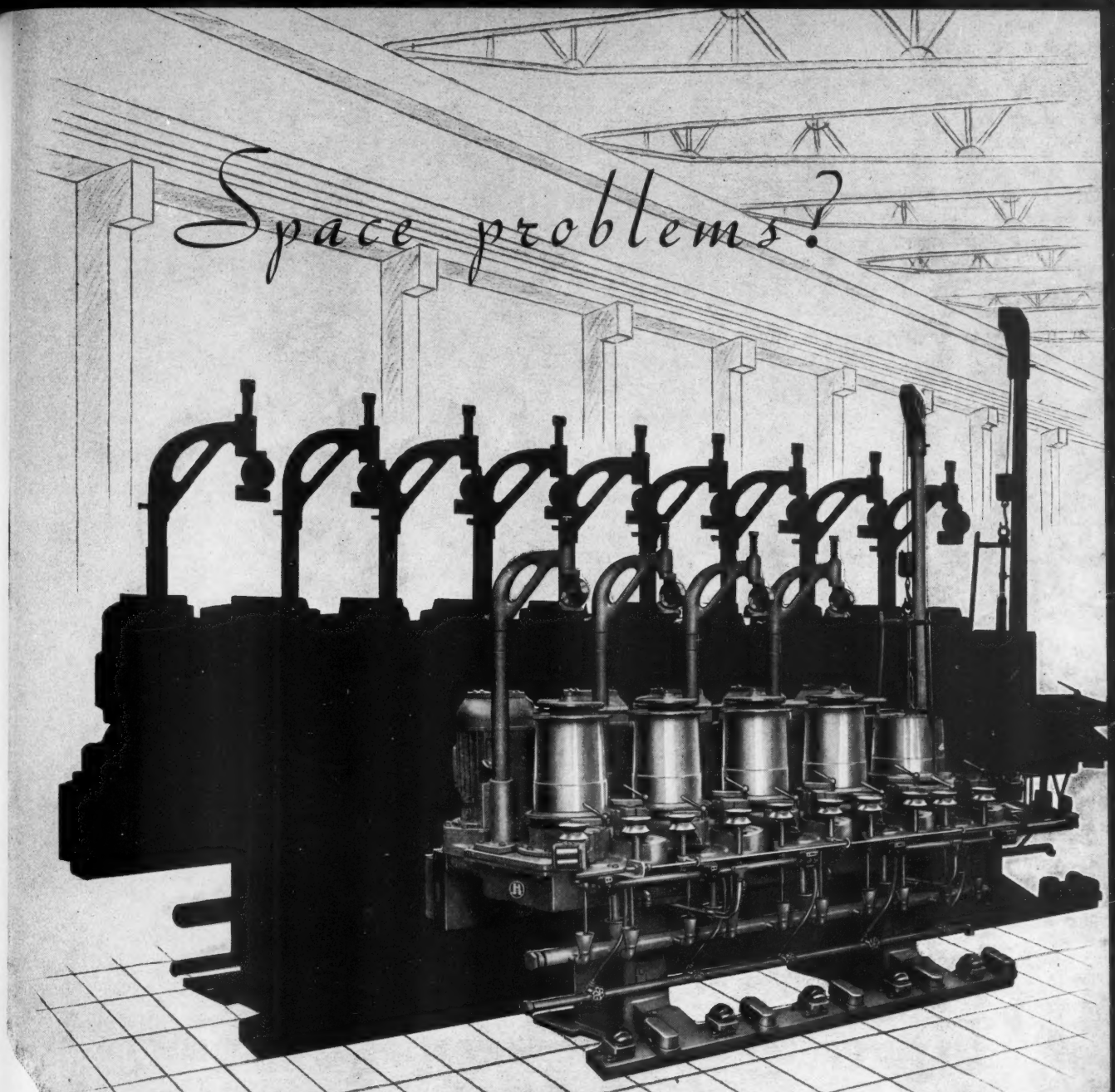
We supply not only the metal-treating chemicals, but also—free of charge—the technical and engineering service to keep them working at top efficiency. We furnish assistance in developing and installing the process, we maintain continuing inspection of the process and equipment if you so desire, we check samples of the processed metals in our Quality Control Laboratories—all these are part of the ACP service at your command.

That's why we say, "We don't stop with the delivery of a chemical—we put it to work and keep it working effectively." And we have been doing this for over 40 years. Write for a booklet describing ACP products and services.

AMERICAN CHEMICAL PAINT COMPANY, Ambler 30, Pa.

DETROIT, MICHIGAN NILES, CALIFORNIA WINDSOR, ONTARIO

CHEMICALS ACP PROCESSES



We Can Help You:

Our multiple wire-drawing machine model GM IIId is equipped with double drafts (two drafts for each spindle). Requirements for space are practically cut in half, yet the machine will produce iron and steel wire smoothly and efficiently.

MASCHINENFABRIK HERBORN BERKENHOFF & DREBES A.-G. **HERBORN/DILLKREIS** GERMANY

Sole Representative in the U. S. A.:

KURT ORBAN CO., Inc., 34 Exchange Place, JERSEY CITY 2, N. J.

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be the judge of diamond quality

It's easy, accurate and low cost with

PRICE:
1st Set 3 Slides $15.00
Additional Slides $5.00

ELGIN'S MASTER COMPARISON GAGES

Recently developed, Elgin's Master Comparison Gages are designed to permit accurate microscopic inspection of diamond abrasives. It means that now—right in your own plant with your own microscope—you can make a fast and efficient check of diamond particles for grading and degree of purity. You can check the proper particle size range, the quantity of fines and the presence of impurities.

Based on U.S. Bureau of Standards specifications, each slide in a gage set indicates the quality you should require. Thus, by comparing your present diamond powder against the master slide, you can quickly determine the quality of the diamond you are using and whether you are getting your money's worth. Examination may be made of particles in the range of U.S. Bureau of Standards grades from 1 micron to 230 mesh. (This is the equivalent of grades from 8 to 2 in powder.)

The price of three master gages, with your choice of grades of diamond, in an attractive plastic box is $15.00. Extra slides are available for $5.00 apiece.

ABRASIVES DIVISION
DEPT. G
ELGIN NATIONAL WATCH COMPANY
ELGIN, ILLINOIS

FREE BOOKLET

Write today for your copy of "Getting your Money's worth with Diamond"...a "must" if you buy diamond powder.

IF YOU MAKE *Springs*

YOU'LL DO BETTER WITH ROEBLING

ROEBLING makes high carbon steel spring wire and flat spring steel... and makes it *better*... for every sort of spring and for every product that requires spring characteristics. Hard drawn, hard rolled, annealed or soft, tempered or untempered ... they're all available to meet your requirements exactly.

Among these Roebling materials are zig-zag and no-sag wires; mechanical and valve spring wires; music wire; clock and motor type spring wires; flat spring steel and upholstery spring wire of all types. The variety of parts into which these are formed is almost endless, but manufacturers all report that Roebling quality and uniformity reduce machine downtime.

Learn for yourself how Roebling can help your production and product. John A. Roebling's Sons Corp., Trenton 2, N. J.

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Subsidiary of The Colorado Fuel and Iron Corporation

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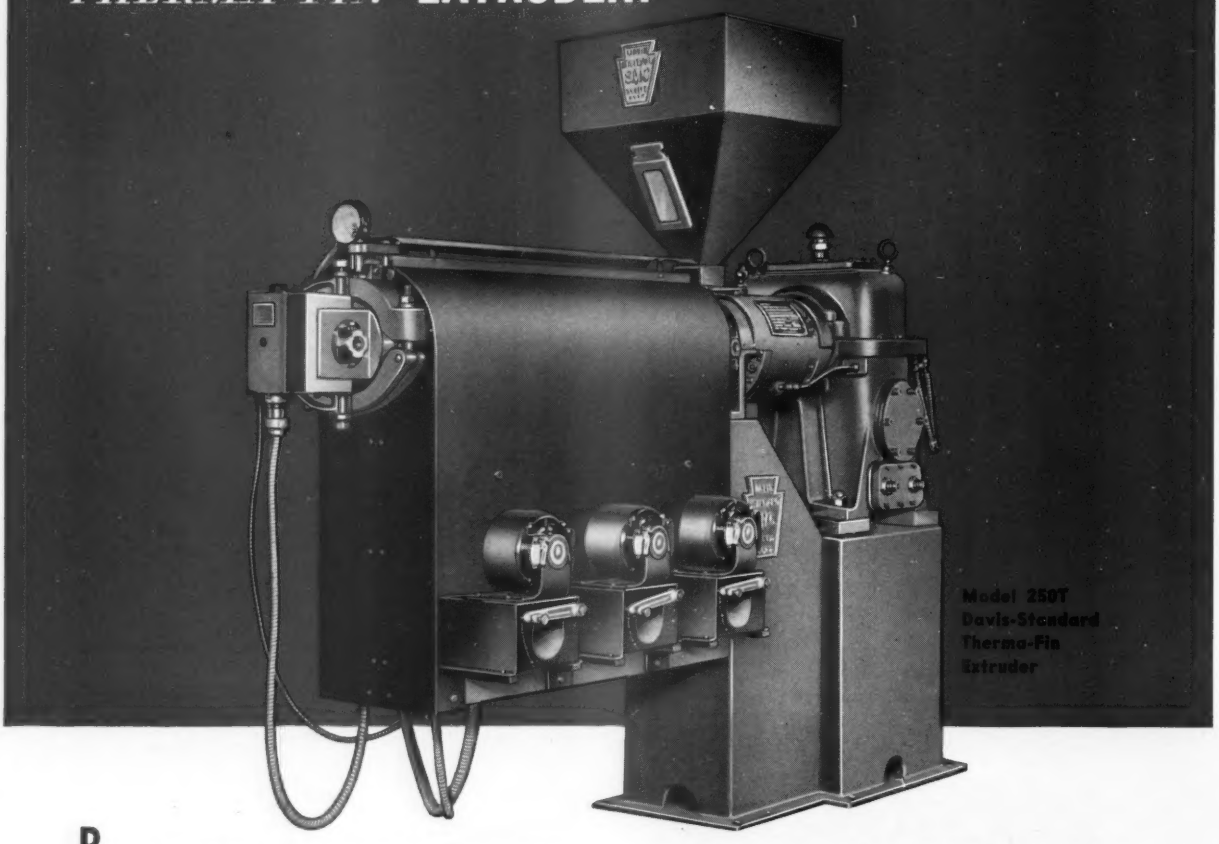
CABLE MANUFACTURER PRAISES PERFORMANCE OF *THERMA-FIN* EXTRUDER!



Model 250T
Davis-Standard
Therma-Fin
Extruder

Better temperature control means better extrusions, improved wire insulation. And the air-cooled Therma-Fin Extruder, according to reports from our customers, provides better temperature control than ever before. Here, for example, is what Mr. Gordon Rollins, Plant Manager of Superior Cable Corporation, Hickory, North Carolina, wrote to us recently:

"The greatest benefit of your better engineered heat dispersion and temperature control is that we can do a much better job in the extrusion of PVC. Your latest design 3¼" extruder gives us more flexible temperature conditions, and better control of stock temperature and appearance. PVC compounds run on this extruder have been considerably more fault free and have a much nicer surface gloss.

"Yesterday we put through a cable having a core diameter of about two inches and an outside diameter of about 2.3 inches with very satisfactory performance on your 4½" extruder. In our opinion, your 4½" extruder is one of the better pieces of equipment available today, since, with proper tooling, this extruder can certainly give excellent results. We are extremely well satisfied with its performance in every respect and feel that you, as the manufacturer, are entitled to a pat on the back."

. . . . . mission accomplished!

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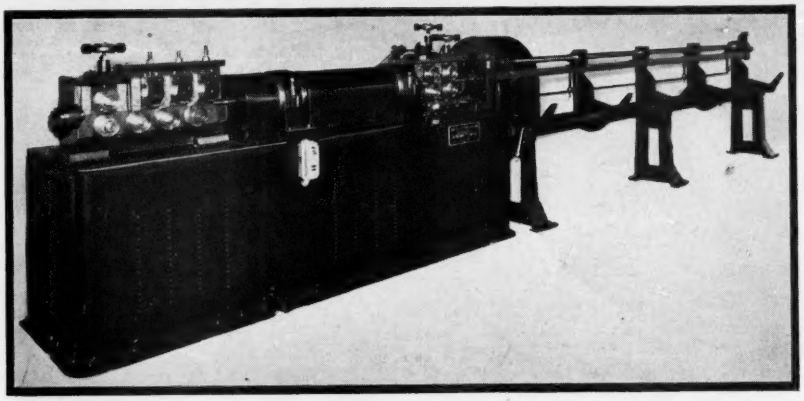
SALES CORPORATION
18 WATER STREET, MYSTIC, CONNECTICUT

SOLE SELLING AGENTS FOR . . . **THE STANDARD MACHINERY COMPANY,** World's Largest Manufacturers of Custom-Built Extruding Machines
IN EUROPE AND THE STERLING AREA, CONTACT FINNEY PRESSES LTD., BIRMINGHAM, ENGLAND

CONTROL IS THE GOOD WORD from SHUSTER



80 YEARS
SHUSTER
AMERICA'S OLDEST NAME IN WIRE STRAIGHTENING & CUTTING

Dual Control 4AV { Straightens and Cuts 3/8" to 11/16" diameter basic wire

Individual Control of Speed and Cut Off

With the Dual Control 4 AV you can run at the most efficient speed for the characteristics of the wire being used. And you get a clean cut at any length. Send for details.

A COMPLETE LINE

Constant Speed Machines **are available for straightening and cutting wire from .025" to ½"**

Constant or Variable Speed Units **with electrically controlled clutch and target are available from 1/16" to ½"**

Other variable speed machines may be furnished to straighten and cut wire up to 11/16"

ALSO

Slide Feed Straighteners **⅜" x 10"; 9/16" x 10"**
Feed Starters **maximum ⅝" diameter**

Tube and Bar Straighteners **7/32" to ⅝" bar; 1" tubing**

Reels **for coils up to 300 pounds**

Send for free, wall-size, split-gauge wire chart, from 41 gauge to 7/0.

SHUSTER
Since 1866
METTLER MACHINE TOOL, INC.
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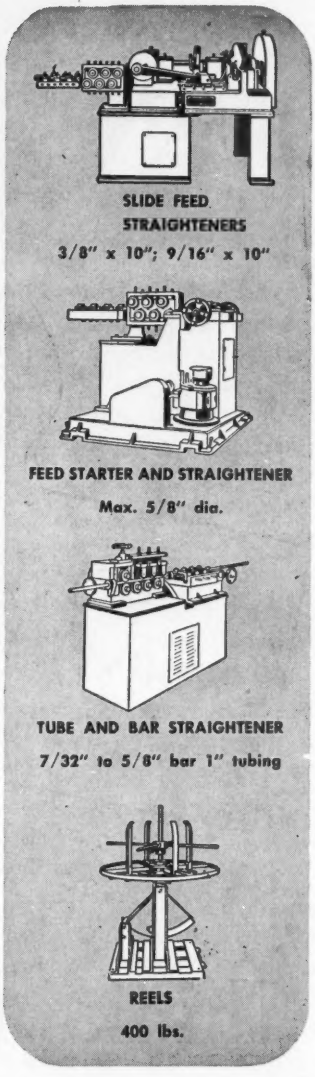

Gentlemen:

Please send us your recommendations. Our straightening and cut-off requirements are as follows:

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City ..... Zone ..... State .....

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KAISER ALUMINUM & CHEMICAL CORPORATION
NEWARK WORKS — HEATH, OHIO
If you're a weaver of insect wire screening...

think of Kaiser Aluminum

STRONG, durable, cladded Kaiser Aluminum fine wire for screening meets or *exceeds* commercial standards and federal specifications—a point worth remembering when you order wire or rod.

Kaiser Aluminum produces 5056 Alclad wire—the strongest of the non-heat-treatable alloys—in .013" and .064" diameters. Redraw rod of this same alloy is available in .375" diameter.

Rigid controls during production assure ductile wire with excellent weaving properties and quality rod that can be drawn at high speeds. Kaiser Aluminum fine wire for screening is cladded for maximum resistance to corrosion.

In addition to wire and rod for insect screening, Kaiser Aluminum also produces these others:

Manufacturers Wire • Rivet Wire and Rod
Welding Wire • Redraw Wire & Rod • Spooled Fine Wire
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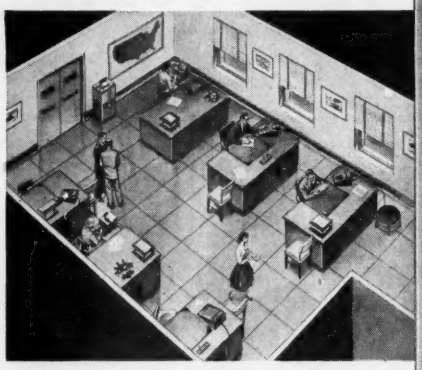
All are available in a wide range of alloys, diameters and tempers.

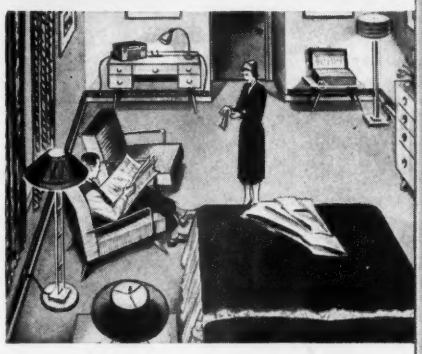
For immediate attention to your needs, contact the Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum and Chemical Sales, Inc., *General Sales Office,* Palmolive Building, Chicago 11, Illinois; *Executive Office,* Kaiser Building, Oakland 12, California.

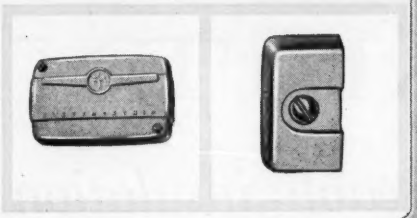
see our catalog in PRODUCT DESIGN FILE or write for copy

a MARVINOL®

"RIGID" Compound forms and insulates BullDog's new ELECTROSTRIP*







ELECTROSTRIP is a new flexible, plastic strip containing two concealed electric wires. Individually-fused receptacle plugs can be snapped into place, instantly, anywhere along its length. This eliminates long, dangerous extension cords and multiple plugs. Installed unobtrusively around the walls or baseboards of a room, office, display area, shop or store, ELECTROSTRIP brings power conveniently to lamps, home appliances, office machines, small tools, and other small electrical units up to a total of 20 amps.

Naugatuck supplies the MARVINOL "Rigid" (non-plasticized) vinyl compound which has proved ideal for this new product because:

- MARVINOL resins form a tough, strong strip which can be bent by hand to fit wall contours and turn corners.
- "Rigid" MARVINOL compounds are far superior to soft or plasticized vinyls in electrical insulating properties. ELECTROSTRIP is listed by Underwriters' Laboratories, Inc.
- The built-in color and smooth, attractive surface produced by MARVINOL resins provide a ready-made, permanent finish which can be painted over if desired.

MARVINOL resins provide compounds with extreme dimensional stability plus a controllable degree of flexibility. They are non-flammable and highly resistant to heat, oils, acids, alkalies and ozone...can be made either transparent or opaque. If you have in mind a new or improved product requiring any or all of these properties, be sure to consult with us about MARVINOL "Rigid" vinyls.

*Reg. & mfd. by BullDog Electric Products Co., Detroit

Naugatuck Chemical

Division of United States Rubber Company

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BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia • IN CANADA: Naugatuck Chemicals, Elmira, Ontario
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Pittsburgh Fiber Glass yarns are made of exceptionally uniform continuous filaments, twisted and plied for any desired buildup. They are packaged for use with all standard types of serving and braiding machinery.

Pittsburgh yarns have proved their high quality with numerous manufacturers. If you have not yet put them to your tests, you are invited to make arrangements through our executive or district sales offices. Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.

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PITTSBURGH PLATE GLASS COMPANY

Here's where you get the answers to steel problems

●Look under "The Youngstown Sheet and Tube Company" in one of these alphabetical or classified phone books.

They represent the 28 conveniently located district sales offices Youngstown maintains across the country. Offices staffed by men who know the steel business. Men who know and understand your steel problems. Men who are qualified to help you get the specific steel you need.

When you want answers to steel problems in a hurry, just call the Youngstown office nearest to you.

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THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

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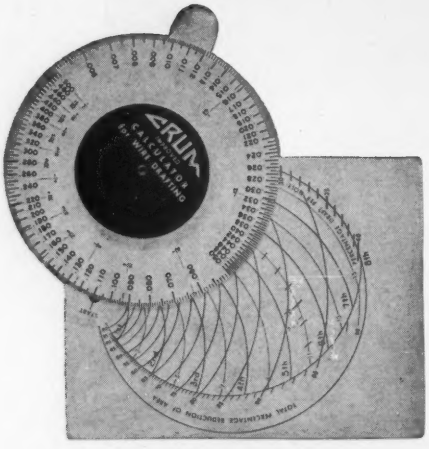
THE NEW and IMPROVED . . .

CRUM CALCULATOR

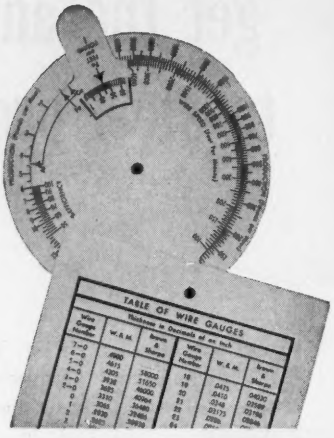
FOR WIRE DRAFTING



Front view of Crum Calculator.

THIS NEW DOUBLE-PURPOSE CALCULATOR WILL:

1. Provide quicker and more accurate information on die sizes and reduction areas;
2. Calculate wire production rates for various speeds and efficiencies.



Reverse view of Crum Calculator.

SOME OTHER FEATURES OF THE CALCULATOR

- Has new scale for more accurate determination of small percentages.
- Gives readings in B & S gauges.
- Intermediate lines provide reductions for 16 holes in one setting.
- New rectangular shaped back for better protection of calculator.
- More legible % draft-per-hole scale.
- Vinyl plastic construction, resistant to wear, warping, dirt, perspiration, wire drawing soaps—can be cleaned.
- Still fits your vest pocket.
- Handy tables of W & M and B & S gauges.
- Feet per pound calculating scale for steel, copper and aluminum wires.
- Durable, accurate, easy to use.

The improved Crum Calculator is worth its weight in gold in time saving —no laborious mathematical calculations necessary when you use it. Instruction sheet with examples accompany each Calculator. You should have one or more in your wire drawing department.

THE PRICE: $5.00 EACH

Send your orders to:

WIRE AND WIRE PRODUCTS

453 MAIN STREET **STAMFORD, CONN.**

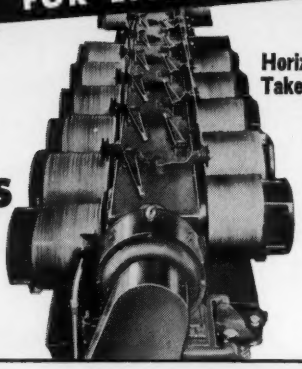
(Exclusive distributors)

Vaughn

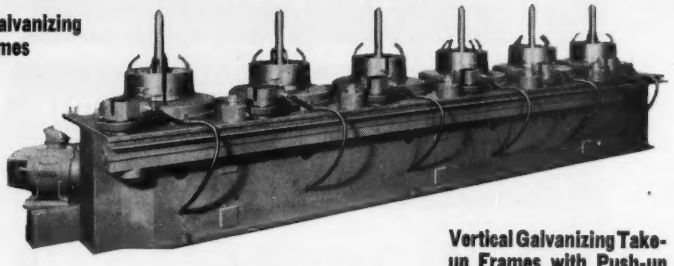
AUXILIARY EQUIPMENT

CORRECTLY DESIGNED—STURDILY BUILT
FOR EFFICIENT WIRE MILL SERVICE

TAKE-UP FRAMES

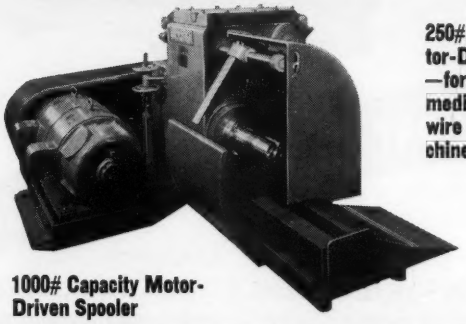


Horizontal Galvanizing Take-up Frames



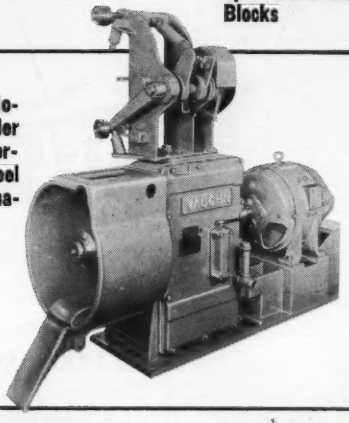
Vertical Galvanizing Take-up Frames with Push-up Blocks

SPOOLERS

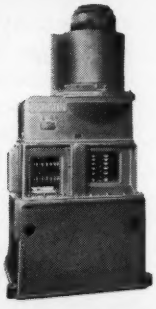


1000# Capacity Motor-Driven Spooler

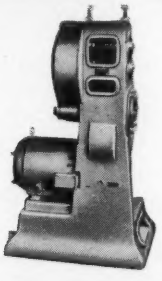
250# Capacity Motor-Driven Spooler—for use with intermediate or fine steel wire drawing machines



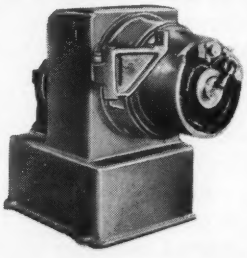
POINTERS and DIE STRINGERS



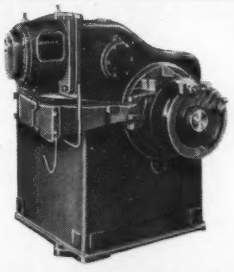
Extra-Heavy Four-Roll Pointer for 1¼" diameter low carbon steel rod



No. 1 Continuous Pointer

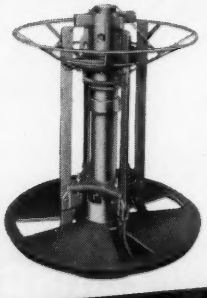


Die Stringer with Pointer

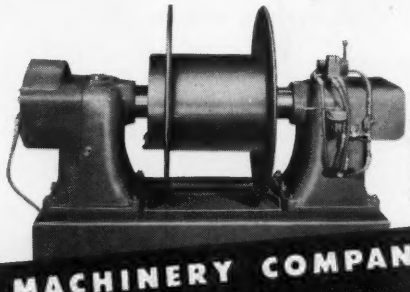


No. 1 Combination Die Stringer & Power Pointer

PAY-OFF MACHINES



Riding Type Block Stripping Spider used with Pallet and Pay-Off Ring as a Pay-Off Reel



4000# Capacity Pay-Off Stand for paying off from large spools

"Quick on the Draw!"

THE VAUGHN MACHINERY COMPANY

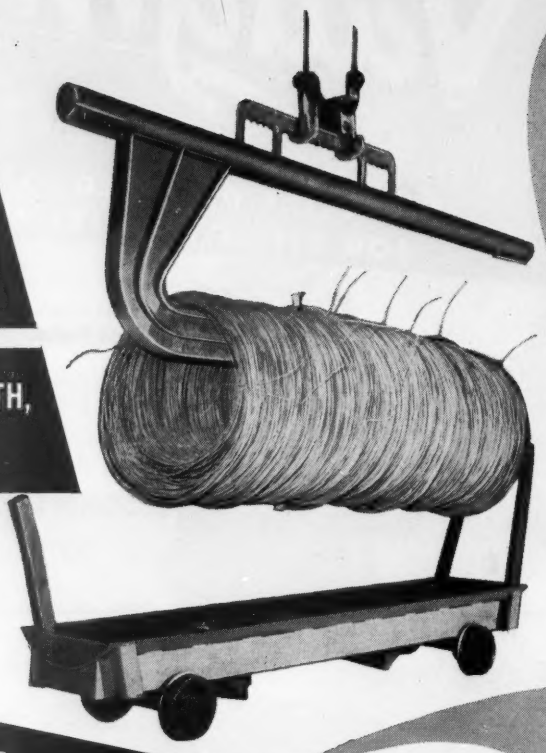
CUYAHOGA FALLS, OHIO, U.S.A.

COMPLETE COLD DRAWING EQUIPMENT Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

Again . . .

WELDCO MONEL HOOKS PROVE THEIR SUPERIORITY

FOR LONGER LIFE, GREATER STRENGTH, EXTRA CORROSION-RESISTANCE



IT'S WELDCO RIGHT DOWN THE PICKLING LINE!

SEVERAL YEARS AGO, a Joliet wire mill ordered 4 Weldco Monel pickling hooks. These hooks soon proved so superior to heavy cast hooks (also in use) that 16 more were installed, and the cast hooks were diverted to lighter service. So once again, as in many other cases, Weldco replaced heavy, old-style hooks right down the pickling line. The reason: Weldco hooks are stronger, lighter in weight, easier to handle, more corrosion-resistant, and carry heavier loads.

The Weldco pickling hook shown above carries 5,000-lb. loads easily . . . has a special notched lifting "bale" for use with a double-crane hook. This design helps balance the load—makes possible rapid, efficient handling, with less manpower needed. Weldco engineers built this hook to meet the requirements of one particular mill, and can do the same for **your** plant.

Depend on Weldco's ingenuity and years of fabricating experience, for all your pickling and liming equipment. Whether you need conventional lightweight Monel hooks or special adaptations, Weldco engineers design and build to meet your exact requirements. For complete pickling information, get in touch with us today.

WELDCO

THE YOUNGSTOWN WELDING & ENGINEERING COMPANY

3723 OAKWOOD AVENUE . . . YOUNGSTOWN 9, OHIO

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The linking together of these two great names in the metal-producing industry offers you their combined engineering abilities, production facilities and craftsmanship in the designing and the construction of rolling mill equipment. It's your assurance of even better service in the production of both ferrous and non-ferrous metals.

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For the FINEST Dies...

Specify

There Are Many Reasons Why V-R Leads The Field!

V-R NEW Cylindrical nib and improved method of assembly insure high degree of concentricity.

V-R . . . First in producing the only Tantalum-Tungsten carbide developed specifically for Drawing Dies.

V-R . . . First to manufacture Carbide Dies with preformed rough cored back relief.

V-R . . . First to furnish Carbide Dies rough cored to finish at hole sizes below .010".

WRITE TODAY for NEW Vascoloy-Ramet Die Catalog VR-461.

The New V-R Die Catalog gives complete ordering information on all V-R Dies for drawing wire, rod, bar and tube.

Vascoloy-Ramet CORPORATION
872 MARKET STREET
WAUKEGAN, ILLINOIS

The Wire Outlook

Indicative of the importance of the automotive industry to our economy, there are 72 million licensed drivers operating 61 million registered motor vehicles on the roads of this country. Many people don't keep a car for ten years, but assuming that the average life is that length of time, it requires a production of over 6 million automobiles a year just to provide replacements.

The American Iron and Steel Institute recently estimated that a typical car weighing 3,542 pounds has in it 155.4 pounds of wire, including the wire in its electrical system. This means that about 933 million pounds of wire are consumed annually by the automotive industry. The items would include bolts, nuts, rivets, screws, seat springs, valve springs, hog rings, control wires, spark plug electrodes, battery, ignition and lighting wires and the like. Just try multiplying the small quantity of any one of these products used in a car by 6 or 7 million, and it represents a tidy business for our industry.

In addition to this, about 200 feet of bead wire is used in each tire manufactured. It is estimated that 2.5 million miles of such wire goes into car tire production annually. And now premium tires are being made with a flexible, high-strength steel wire in the tread. If this trend spreads, it will consume vast additional quantities of wire.

A related use of wire is found in highway and street constructions for reinforcement. Automobiles are said to be rolling up more than 560 billion miles a year. This wears out and antiquates old roads, necessitating the use of many thousands of tons of reinforcement mesh for rebuilding and new construction. It is estimated by State Highway Departments and the U. S. Bureau of Public Roads that $101 billion will be needed for road and street construction in the next ten years.

Merchant wire product sales jumped up with the harvesting season, and manufacturers' wire, particularly spring, is showing up well in market demand. Merchant products, however, can be expected to be slow during the early winter months. Building wire items are continuing in strong demand. Mill schedules for hard drawn are filled. Because of flood repair work and large purchases for railroad equipment, the fastener manufacturers are keeping busy meeting demands. Bedding and furniture spring wire is moving actively. Rope wire buying is heavier.

Domestic manufacturers are encountering considerable competition from foreign producers of nails and fencing. The principal sources for these items are Belgium and Japan. This competition is being felt mostly by the Midwest mills.

There is some talk going around about the possibility of a business decline. As business leaders and economists look for a continuation of high levels, such conversation may be laid to the political wishful thinking and maneuvering of the "outs." They are not only expressing doubts as to the soundness of our economy, but are questioning many other aspects of the current administration's policies.

As we approach a presidential election year, the tempo of expression of these doubts and fears will be stepped up by the aspiring New-Fair Dealers, although the fact remains that business is good, not because of pump priming projects, but because of the confidence business men have in the good judgement and integrity of our leaders in Washington.

An indication of the prospects for the future may be found in the rash of expansion plans to which a large number of big companies have committed themselves. These plans are taking the form of plant modernization, plant expansion and the acquisition of other concerns.

Before the big political guns start firing next year, we can at least enjoy a happy holiday season and we hope that your Christmas will be a merry one, and your New Year replete with prosperity and achievement.

—from the Editor's Desk

to the friends we've made
and the ones we hope to make—
a very

MERRY CHRISTMAS

—and a prosperous New Year!

Steelskin
LUBRICANTS

R. H. MILLER
Company, Inc., Homer 1, N. Y.

WIRE
AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 30 December, 1955 No. 12

Stress Corrosion and Relaxation of High Carbon Steel Wire for Prestressed Concrete

by Dr. Fritz Schwier
Chief Engineer, Wire Department
Felten and Guilleaume Carlswerk
Köln-Mülheim, Germany

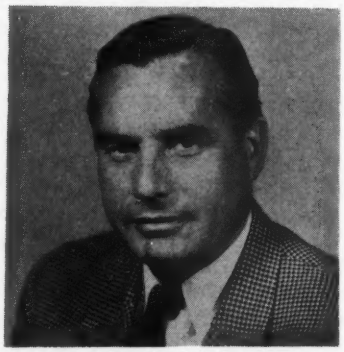
Everyone engaged in the production of high carbon steel wires will agree that during the last years the percentage of such wires which were to be used for prestressed concrete has steadily increased and certainly will increase further.

★ ★ ★

The principal requirement for steel wire in prestressed concrete as the sole carrier to take the prestress, besides high tensile strength and elastic limit, is absolute safety against slackening of the prestress in course of time and—in bonded prestressing—an absolute bond between steel wire and concrete.

★ ★ ★

A second feature which must be required to-day for high tensile wires for prestressed concrete is sufficient safety against rupture. This means that the yield point tensile strength relation should not become unfavourable so as to make the wire brittle. Surface defects or bending, for example, will more frequently tend to breakages,



Dr. Fritz Schwier

The author was born in Dortmund in 1911. After completing his university training at the Aachen Technical School, he was employed by Felton & Guilleaume Carlswerk Eisen und Stahl Aktiengesellschaft as an engineer. He is now the Chief Engineer in the Wire Department.

Dr. Schwier presented this paper at the Annual Convention of The Wire Association in Chicago, Illinois, on November 16, 1955.

the less favourable this relationship between yield point and tensile strength is.

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Sufficient toughness which is guaranteed by the number of bends in the bending test is an indispensible requirement for the safety against notch sensitivity and against rupture in the anchor plates.

★ ★ ★

Likewise it is important that the wire possess a certain cold working capacity. The amount of this cold working capacity which is needed for taking up stresses outside of the elastic range, or of the working stresses is given by the elongation at rupture and the reduction of area.

★ ★ ★

Another requirement, which on account of recent experience must be fulfilled by such wires for prestressed concrete, is the highest possible resistance to stress corrosion. Also the fatigue limit must be known, although in prestressed concrete constructions the dynamic stresses which are superimposed on the static stresses are usually low. In practice, however, curves in the wire, anchor plates which are not at right angles to

the wire axis and surface defects may impair the fatigue strength.

* * *

For a critical examination of a wire to be used in prestressed concrete constructions, therefore, the following properties must be known: tensile strength, yield point, elastic limit, modulus of elasticity, stress-strain diagram, elongation at rupture, reduction of area, number of bends in the bending test, creep, resistance to stress corrosion and fatigue limit. With regard to the make-up of the wire to be supplied, it is essential that the coils should have such a diameter that the wire after uncoiling lies absolutely straight. To achieve this it is necessary that the wire is straight before coiling and that it is coiled in the elastic range.

* * *

The wire surface must be suitable to allow bonding in the concrete or for the anchorage.

* * *

The weight of the coils should be sufficiently heavy and the admissible variation in all the properties as small as possible. There were two properties especially about which the steel producers could not say too much in the beginning: behaviour under stress corrosion on the one side, creep and relaxation respectively, on the other. Experiments were therefore started in order to study these problems, and I would like to report to you some recent investigations which were carried out with

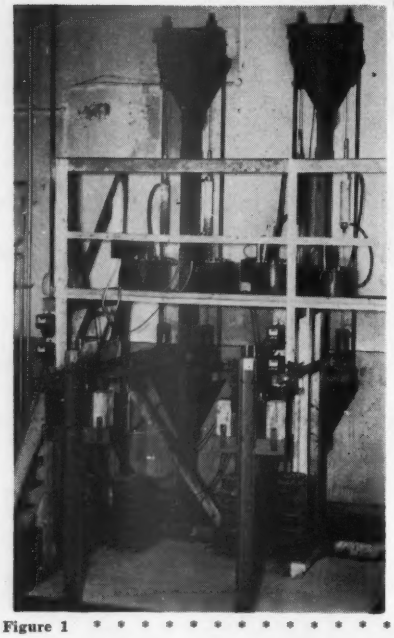

Figure 1

high carbon steel wires produced in different ways.

1. Stress-Corrosion Tests

In several large prestressed concrete structures breakages occurred recently during and after prestressing of oil-tempered steel wires. They were positively recognized as a result of intercrystalline corrosion attack and gave occasion to investigate more closely the behaviour of several kinds of steel regarding stress corrosion. Among the investigations which became known in the literature, so far chiefly the papers by **W. O. Everling** and **G. T. Spare** deal with high carbon steel wires for prestressed concrete, while out of the remaining papers, which do not especially deal with drawn or oil-tempered wire, reference should be made to **W. Raedecker's** paper.

* * *

I regret that the time I have for reading this paper is too short to tell you some of their results. But I hope you will recall that the investigations which were made with drawn and oil-tempered wires did show a remarkable difference.

* * *

Our own experiments tried to imitate very closely practical conditions. They were carried out by means of a lever system arrangement which previously had been used for creep tests.

* * *

Fig. 1 shows the apparatus on which 4 wires can be tested simultaneously. The length of the specimens was 2 metres; the test length proper, within which the wire is attacked by a hot solution of calcium-ammonium nitrate was 1 metre. The corroding agent was heated by steadily circulating hot oil of 212° F around the tube which contains the corroding solution. Different loads could easily be applied by means of a weight and lever system.

* * *

For our tests the following wires were used:

a) drawn, not stress relieved
b) drawn, stress relieved
c) oil-tempered
d) air patented.

* * *

The load range was between 25

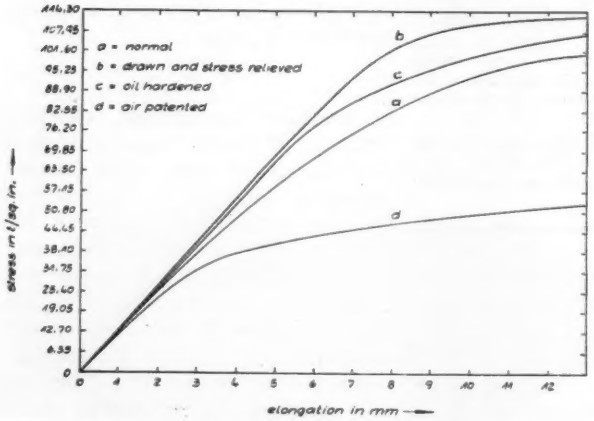

Fig. 2 Stress-strain diagram of several 0,209"-wires

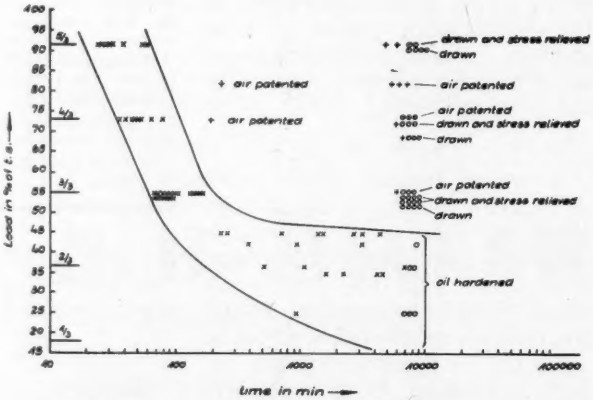

Fig. 3 Stress corrosion resistance of steel wires after various treatments

and 92% of the ultimate tensile strength of the wires to be tested. They had the following mechanical properties (averages of 3 values).

	Tensile strength σ B t/sq.in.	Yield point σ 0.2 t/sq.in.	Elastic limit σ 0.01 t/sq.in.	Elongation at rupture (L=10xd) %	Bends (r=0.5")
a)	116	85	33	7.0	6 - 7
b)	118	108	79	9.0	4 - 5
c)	95	82	75	9.0	2 - 3
d)	74	43	21.5	10.0	3 - 4

Fig. 2 gives the stress-strain diagrams of the wires. They show a typical well known shape. The wires originated from one single heat with the following chemical analysis:

C	Si	Mn	P	S	Cu	Cr	N_2	Al
0.84	0.22	0.67	0.017	0.018	0.16	0.05	0.006	0.004 %

The microstructure of the wires corresponded to the mechanical and heat treatments which had previously been applied to them. The testing apparatus has an automatic switch, which interrupts the circuit of an electric clock as soon as a specimen breaks, thus the exposure lives of the specimens could easily be determined.

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Fig. 3 shows the behaviour of the wires which we investigated. The ordinate axis gives the load in % of the ultimate tensile strength. The abcissa corresponds on a logarithmic scale to the time which elapsed until the specimen broke. Failures are indicated by crosses; wires which did not break were taken out after about 7000 minutes (= 120 hours). The results indicate that at stresses equal to 55% of the ultimate tensile strength of the wire, which is the stress ordinarily used in prestressed concrete, the drawn and drawn and stress relieved wires have an exposure life of more than 7000 minutes, whereas the oil-tempered wires altogether broke within 70 — 160 minutes. Of the air-patented wires only one specimen did not last 7000 minutes, but failed after 6000 minutes. At higher stresses of 73 and 93 % of the UTS the oil-tempered wires lived only 42-80 and 25-40 minutes respectively, the drawn and stress relieved wires on the other hand were not yet broken after 7000 minutes. At the highest stress of 92% the wires were destroyed by creep on account of the high specific stress. The air-patented wires evidently arrange themselves between the oil-tempered and the drawn wires, as is shown by the results obtained under a stress of 82%. For the oil-tempered specimen only at stresses lower than 45% exposure life begins to show some improvement, although occasionally at stresses as low as 25 and 35% wires fail after 1000 minutes.

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The load scatter range shows how easily under the test conditions described above an oil-tempered wire is attacked by stress corrosion at low stresses.

★ ★ ★

Now the temperature of the corroding solution was lowered and the exposure life of the oil-tempered wires at 53% of the UTS investigated. The specimens were taken from another coil of the same heat.

★ ★ ★

Fig. 4 shows the results. The ordinate gives the temperature of the corroding agent, the abcissa the time until the specimen breaks. At 212° F we obtained the same values as before. At 158° F failure occurred after 900—1400 minutes, at 104° F no specimen of the 4 wires broke.

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The relationship between exposure life and testing temperature therefore can be regarded, under the here prevailing test conditions, as a straight line one.

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The results, and especially the results obtained with the oil-tempered wire, made it probable that a very distinct intergranular corrosion must have taken place which would impair considerably the fatigue limit of the wires. The same likewise was to be expected for the drawn wires, although the liability to become cracked by stress corrosion is less for such wires than for the oil-tempered specimens. For this reason ordinary fatigue tests were carried out with the

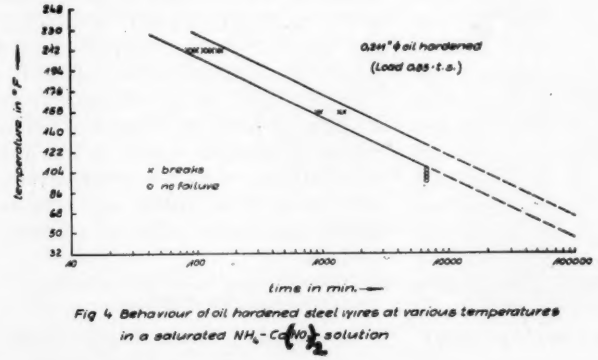

Fig 4 Behaviour of oil hardened steel wires at various temperatures in a saturated NH_4-$Ca(NO_3)_2$ solution

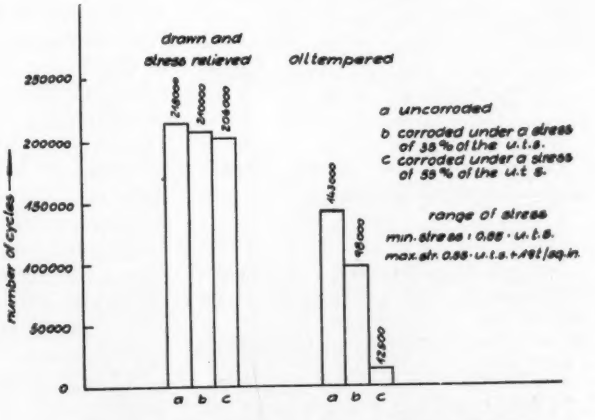
drawn and stress relieved
oil tempered
number of cycles
a uncorroded
b corroded under a stress of 35% of the u.t.s.
c corroded under a stress of 55% of the u.t.s.
range of stress
min. stress : 0.85 · u.t.s.
max. str. 0.85 · u.t.s. + 1 kg/sq.mm

Fig. 5 Number of cycles endured by drawn and stress relieved and by tempered wires after stress corrosion attack

specimens which had been used in the corrosion tests.

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The tests have been carried out so far only with oil-tempered and with drawn and stress relieved wires, which have been tested at a stress of 55% of the UTS in a corroding solution of 212° F.

★ ★ ★

Thus the oil-tempered wires had been exposed to the stress corrosion attack for about 100 minutes, the drawn wires for about 7000 minutes.

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As minimum stress in the fatigue tests was chosen 55% of the UTS, equal to 53 t/sq.in for the oil-tempered and 66 t/sq.in. for the stress relieved wires. The stress range was 19 t/sq.in. As a comparison the same tests were run with uncorroded wires of the same material. We found the following numbers of cycles (average of 10 specimens):

★ ★ ★

	uncorroded	corroded
Oil-tempered	143,000	125,000
Drawn and stress relieved	218,000	206,000

★ ★ ★

The results induced us to carry out the same experiments with wires which had been corroded at stresses of only 35% of the UTS since under these conditions the exposure life of oil-tempered wires is already considerably improved. The time during which the specimens have been exposed to corrosion in this case was 1000 minutes for the oil-tempered and 7000 minutes for the drawn wires. The minimum stress and the stress range were the same as before.

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These are the results (again average of 10 specimens):

★ ★ ★

	uncorroded	corroded
Oil-tempered	143,000	98,000 cycles
Drawn and stress relieved	218,000	210,000 cycles

★ ★ ★

Fig. 5 shows the number of cycles which were endured by the wires with and without previous corrosion attack. For the oil-tempered wires the number of cycles was brought down to 9% at a corrosion stress of 55% of the UTS and to 68% at 35%. For the drawn and stress relieved wires the figures are 94.5 and 96.3% respectively.

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I do not believe it justified at this time to draw too far-reaching conclusions from these results. It is evident that it is not yet possible to compare both kinds of steel on account of these tests since the corrosion times are not the same in both cases.

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With about 50% of the corroded oil-tempered specimens we got failures immediately at the start of the fatigue test; the rest, however, still endured the number of cycles given above. We shall have to continue these experiments under somewhat varied conditions. These fatigue tests, anyhow, prove that the surface of the drawn wires, too, was attacked by stress corrosion. This attack had not yet resulted in a break under static load and the fatigue strength was not considerably impaired. We intend to vary still more the times and stresses of the corrosion tests for all wires ordinarily used in prestressed concrete. By fatigue tests carried out in the described manner, it will be possible to find out rather exactly the degree of corrosion attack even without failure.

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In the same way as Everling and Spare we, too, found that typical stress corrosion cracks in oil-tempered wires travels in a more or less transaxial direction, whereas in the drawn and drawn and stress relieved wires they progress in more or less semi-axial direction. The lower resistance of oil-tempered wires to stress corrosion that we found is not surprising if it is considered that oil-tempered material, on account of its finer crystalline structure, contains considerably more grain boundaries, which will give to the corroding agent much better access than drawn material with grains, which are greatly elongated by cold working. This different crystal size also causes the typical forms of the cracks in both steels. Another point supporting the lower resistance of the oil-tempered steel probably is the surface stresses which are caused by the heat treatment. More important is, however, in our opinion the number of grain boundaries, the more so as it is believed that the corrosion attack is caused by an electric potential set-up between the precipitations at the grain boundaries which become anodic, and the grain proper.

★ ★ ★

At the Second Congress of the International Federation of Prestressed Concrete which was held last August in Amsterdam, the question of stress corrosion in connection with spontaneously occurring wire breaks played an important roll. Although not every sudden wire failure can be traced back to stress corrosion and that also general corrosion, pitting, notch sensitivity as well as hydrogen embrittlement must be taken into consideration, one is compelled, in any case, to consider the possibility of stress corrosion. Especially is this so when using steel qualities which evidently show a low resistance. Producing coils with large diameters and wrapping do not suffice by themselves, if one takes into consideration that frequently the steel wires lay unprotected in the concrete channels before injecting.

★ ★ ★

There can be no doubt—and this was confirmed in Amsterdam—that it is justified at the present time, if possible, not to use oil-tempered steel wire for prestressed concrete under unfavourable corrosion conditions. We ourselves got good results by supplying oil-tempered steel wire to factories which manufacture mass-produced prestressed concrete units where it is worked under constant and safe conditions and where ribbed and profiled wire which is ordinarily employed for this purpose, has advantages from a financial point of view. For other purposes, bridges, tanks, tubes, and open building sites where prestressed concrete is used, we supply drawn and stress relieved wires or strands.

2. Relaxation

A second problem which in the

beginning presented itself to the producers of steel wires to be used in prestressed concrete was the creep of the wires and especially the loss of stress caused by creeping (relaxation). For this statistical calculation, the engineer must know the amount of relaxation to be expected. On the other hand, the first relaxation tests showed that neither from the stress-strain-diagram nor from the creep tests at constant load which were carried out more frequently in the beginning, could the relaxation behaviour be established. Therefore, systematic investigations with constant gauge lengths were started and the results published. Besides the fact that the test conditions varied, especially as regards the gauge length, the amount of initial stress, the mechanical properties etc., in some experiments the length of the duration of the tests in our opinion was not sufficient. Relaxation tests, if carried out, should last at least 1000 hours. Furthermore, they should be made at various initial stresses, thus making it possible to examine the wire most thoroughly, especially since often higher local stresses must be taken into consideration, for instance at places where the direction of the wire is changed by the spacers. Although some information concerning experiments about relaxation behaviour has been published, I would like to tell you briefly about our 1000-hour-experiments which we carried out during the last year with different wires and strands. Firstly, I want to remark that exact values are to be expected only if the relaxation tests are carried out with really straight wires at constant temperature. In earlier investigations we had found that the level of the elastic limit plays a very important role in the behaviour in creep and that any measure which varies the elastic limit, likewise varies the creep behaviour in the same direction. Although I believe that the influence of a stress relieving heat treatment on the technological properties of a drawn steel wire is known to you, I would like to show you in Fig. 6 once more the variation in elastic limit, yield point and ultimate tensile strength which is brought about by various stress

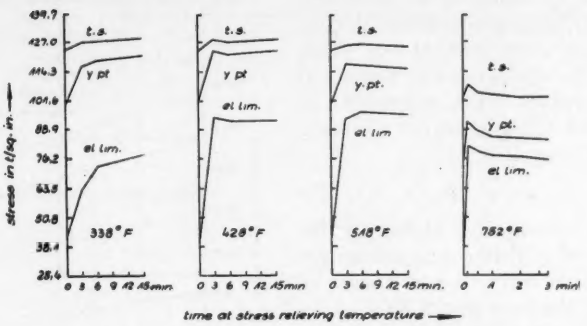

Fig. 6 Technological properties of an indented cold drawn steel wire (0.23% C) after various heat treatments.

relieving temperatures and times. From these curves you will recognize how much it is possible to raise especially the elastic limit and how advantageous is a stress relieving temperature of 752 F, since here the relationship of the yield point to the tensile strength does not become too large in spite of a considerable increase of the elastic limit. The time needed for this purpose is only 10 seconds if a lead bath is employed. Another advantage of this treatment consists in the fact that simultaneously the elongation at rupture is improved which is contrary to results obtained with wires, stress relieved at lower temperatures. The properties before the stress relieving treatment indicate clearly that at this temperature wires with lower tensile strength had been investigated. Wires and strands to be used for prestressed concrete are usually stress relieved in this way at our factory.

* * *

Fig. 7 a and b show one of our test installations for creep and relaxation tests. The specimens are loaded by means of levers and weights. The elongation is determined by a dial indicator which has a unit measurement of 0.0002″ and which is fastened over a gauge length of 1 metre. The testing accuracy, therefore, is 0.0005%. In relaxation tests the zero point elongation is continually adjusted by diminishing the load, thus the loss of stress is determined. Usually, the tests are carried out simultaneously with several specimens. The values given in this paper therefore represent average values obtained from several specimens. In the creep tests drawn as well as drawn and stress relieved wires and strands of a normal low Mn and Si alloyed carbon steel were

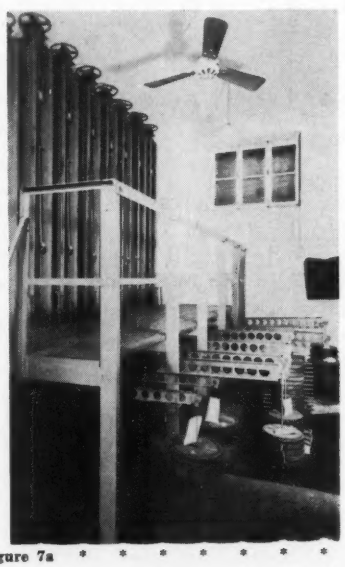

Figure 7a * * * * * * * *

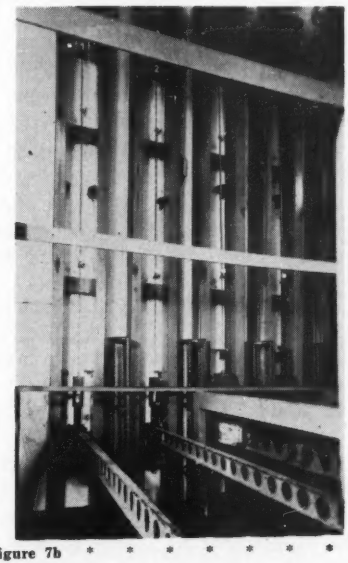

Figure 7b * * * * * * * *

employed. In addition to these experiments, also creep tests at constant load were carried out with most of the material. The loads and initial stresses were expressed in percent of the respective ultimate tensile strength.

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Fig. 8 shows the stress-strain-diagram of a drawn and stress relieved 0.197″ wire. It can easily be seen how the curves are shifted by the stress relieving treatment. The same is shown in **Fig. 9** for a 7 x 0.118″ strand.

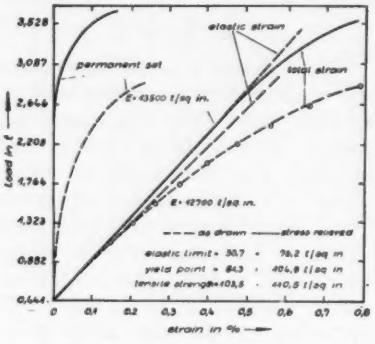
elastic strain
permanent set
total strain
E = 13500 t/sq in.
E = 12700 t/sq in.
as drawn
stress relieved
elastic limit = 80,7 » 78,2 t/sq in
yield point = 84,3 » 104,8 t/sq in
tensile strength = 103,5 » 110,5 t/sq in
Load in t
strain in %

Fig. 8 Stress-strain diagram of 0.197″ steel wire as drawn and stress relieved.

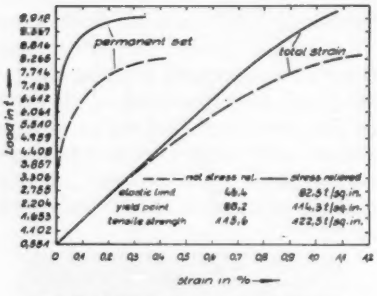

Fig. 9 Stress-strain diagram of strand 7×0.118″, as drawn and stress relieved

It is important to mention that the wires as well as the strands, stress relieved or not, were perfectly straight. It can be seen that stress relieving has the same influence on strands as on wires.

★ ★ ★

Fig. 10 demonstrates the relaxation of an unrelieved wire after 1000 hours at initial stresses of 55, 65, 75, 85 and 92% of the UTS. It amounts to 5.7, 7.7, 8.8, 9.8 and 11% of the corresponding initial stresses. Since the relaxation curves proceed at every stress in

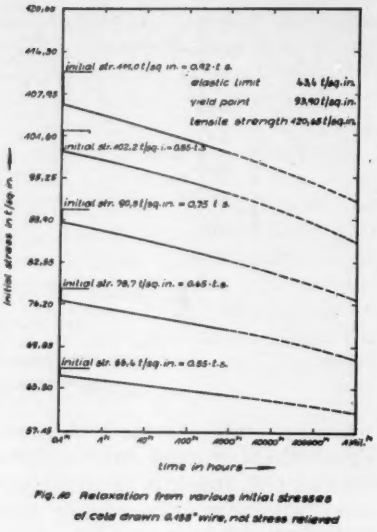
initial str. 441,0 t/sq in. = 0.92 · t. s.
elastic limit 43,4 t/sq.in.
yield point 93,90 t/sq.in.
tensile strength 120,65 t/sq.in.
initial str. 402,2 t/sq. i. = 0.85 t.s.
initial str. 90,8 t/sq. in. = 0,75 t. s.
initial str. 78,7 t/sq. in. = 0.65 · t. s.
initial str. 66,4 t/sq. in. = 0.55 · t. s.
initial stress in t/sq in.
time in hours

Fig. 10 Relaxation from various initial stresses of cold drawn 0.158″ wire, not stress relieved

approximately the same manner till 1000 hours, one is encouraged to extrapolate the curves to 1 million hours (=110 years) which would lead to values of 9.5, 13, 15.4, 17 and 19% respectively.

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Fig. 11 gives the relaxation curves of a stress relieved low Mn and Si alloyed carbon steel wire. It can be seen that these wires show only a small amount of creep, especially the ones with a higher carbon content. These wires contained from 0.8 to 1.0% of Mn and 0.75 to 0.85% of Si. For the steel quality "85 Mn Si" the relaxation after 1000 hours at an initial stress of 56% of the UTS amounts only to 0.8%, at 60% to 1.3%. Extrapolation to 110 years will result in a relaxation certainly not exceeding 2.5%.

Fig. 12 summarizes some results with strands 7 x 0.118″ which had not been stress relieved. Several tests were carried out with specimens cut from the same strand, because a great variation in the results was experienced, contrary to the results in testing single wires made from the same material which were almost exactly alike. If it is considered that a strand does not possess a uniform sectional area as compared to a wire and further that transversal forces are introduced by the loading and that the wires never lay entirely straight in the strand, the discrepancies in the results will not be surprising. The average values show after 1000 hours, relaxation losses of 6.8, 9 and 11. 2% at 50, 60 and 70% initial stress respectively. Different conditions exist for stress relieved strands as shown in **Fig 13.**

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Here the values obtained in repeated experiments with the same specimens are approximately the same as in the experiments with stress relieved wires. The relaxa-

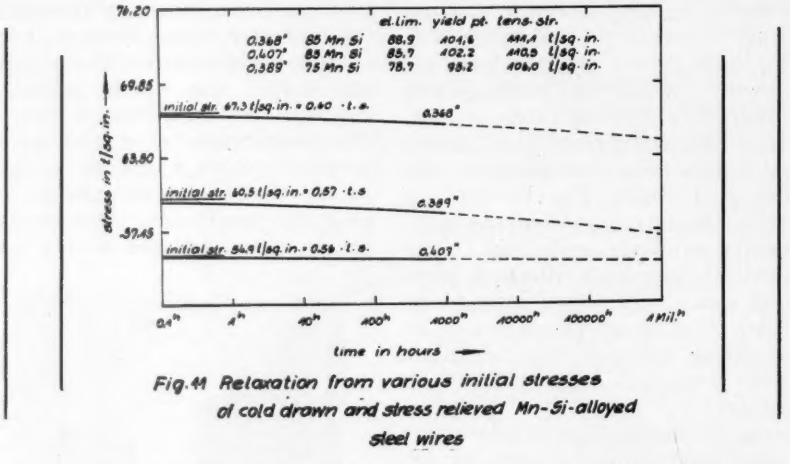
el.lim. yield pt. tens. str.
0,368″ 85 Mn Si 88,9 104,6 111,1 t/sq. in.
0,407″ 85 Mn Si 85,7 102,2 110,5 t/sq. in.
0,389″ 75 Mn Si 78,7 95,2 106,0 t/sq. in.
initial str. 67,3 t/sq.in. = 0.60 · t. s.
0.368″
initial str. 60,5 t/sq.in. = 0,57 · t. s.
0.389″
initial str. 54,9 t/sq.in. = 0.56 · t. s.
0.407″
stress in t/sq.in.
time in hours

Fig. 11 Relaxation from various initial stresses of cold drawn and stress relieved Mn-Si-alloyed steel wires

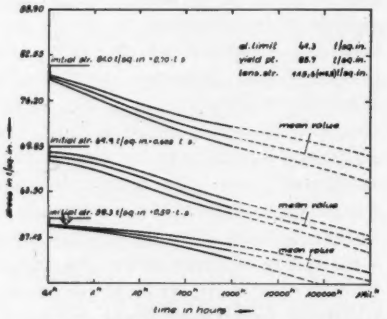

Fig. 12 Relaxation from various initial stresses of a 7×0.118″ strand, not stress relieved

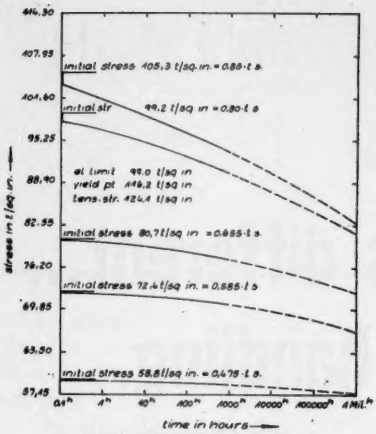
initial stress 105.3 t/sq.in. = 0.88·t s.
initial str 99.2 t/sq in = 0.80·t s
el. limit 99.0 t/sq in
yield pt 114.2 t/sq in
tens-str. 124.4 t/sq in
initial stress 80.7 t/sq in = 0.655·t s.
initial stress 72.4 t/sq in. = 0.585·t s
initial stress 58.8 t/sq in. = 0.478·t s.
stress in t/sq in.
time in hours

Fig 13 Relaxation from various initial stresses of a stress relieved 7×0.118" strand

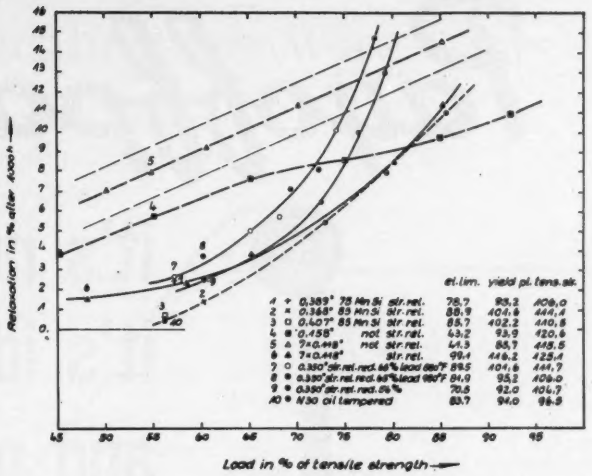

Fig. 14 Relaxation of stress relieved and not stress relieved cold drawn steel wires and strands from various stresses

tion we found here are 23, 3.8, 8.5 and 11.2% at stresses of 58, 65, 80 and 85% respectively. These results thus are similar to the results which we obtained with stress relieved wires. It is justified to assume that stress relieved strands, if they are not prestressed with stresses higher than 65% of the UTS, will lead in 110 years to a relaxation which will not exceed 7 to 8% if they are well straightened and stress relieved in a proper manner.

stresses up to 70% of the UTS show large losses by relaxation which are higher than the losses suffered by unrelieved wires. The results obtained with the Mn-Si-steels in the stress relieved condition show up very favourably. With these steels we shall have to carry out some more experiments with initial stresses exceeding 60%. The stress relieved normal carbon steels show at 70% about the same

the relaxation losses amounts to 1 to 2%. The Mn-Si steels, which were employed here, have a lower ductility in the patented condition than a normal carbon steel. In my opinion it is therefore very probable that a total reduction in area of 65% already is unfavourable for these steels with regard to creep.

* * *

Another point in which we were

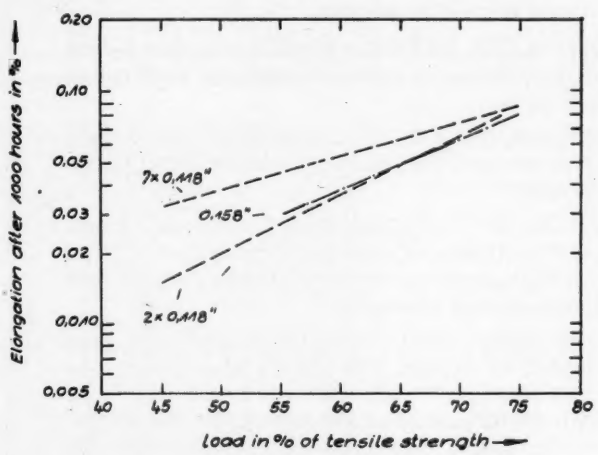

Fig. 15 Creep of cold drawn 0,158" steel wire, 7×0,118" strand and 2×0,118" strand, not stress relieved, at various stresses.

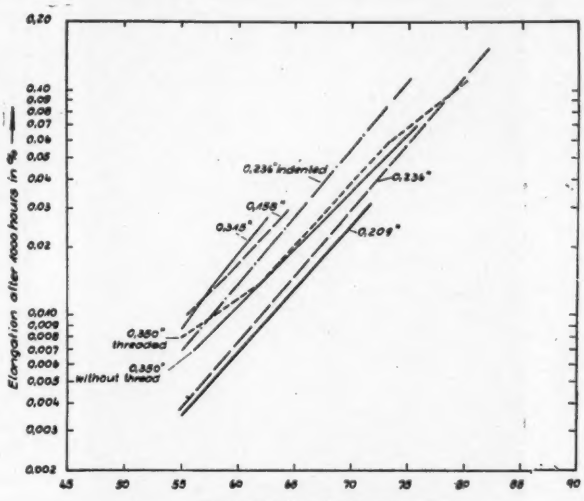

Fig. 16 Creep of various cold drawn and stress relieved steel wires at various stresses

Fig. 14 summarizes some most typical values. It clearly makes visible the different behaviour of the material investigated in these experiments. From this diagram it can be seen that the unrelieved strands at the customary initial

results as the stress relieved strands. Here we found the interesting fact that wires drawn with a smaller reduction in area distinctly behaved better. When comparing curves 7 and 8 with curve 9, it is to be seen that the difference in

interested was the temperature of the lead bath used in the patenting process. Wires were, therefore, tested which differed only in the fact that they had been patented

(*Please turn to page* 1519)

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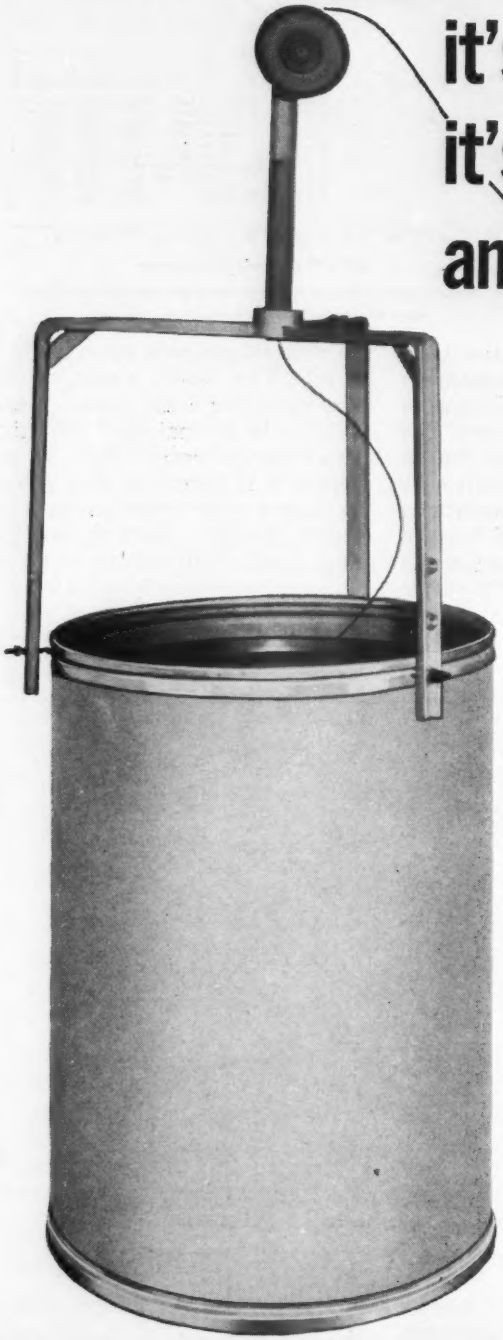

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High Convection Annealing for Wire Coils

by James L. Whitten, Vice President
The Lee Wilson Engineering Company, Inc.
Cleveland, Ohio

This paper was prepared for delivery at the Annual Convention of The Wire Association in Chicago, Illinois, on November 14-17, 1955.

The purpose of this paper is to describe the application of extremely high velocity gas recirculation known as high convection to the annealing of rod and wire coils. The application of this high convection system has enabled the fuel inputs to bell-type annealing furnaces to be increased sharply, as the high convection system has made it possible to utilize a great deal more heat by convection transfer to the charges. This paper will describe the method of applying this increased fuel input of this high convection system to bell-type annealing furnaces for use in the wire industry.

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The Lee Wilson Engineering Company was exploring the possibility of improving production yields and producing more uniform physical properties in annealing furnaces at the conclusion of World War II, and at that time developed the first high convection furnaces for annealing steel strip coils.

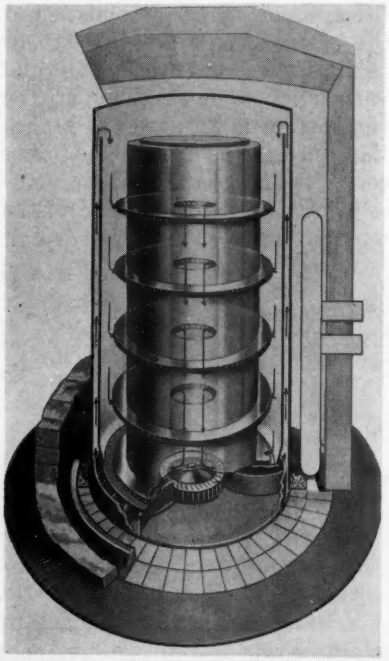

Figure 1.—Cutaway view of high convection annealing system.

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Material of this kind is annealed by what we call a full convection system, such as is shown on Fig. No. 1. This shows the heat source as coming from a surrounding ring of O-type radiant firing tubes, a transfer medium through the inner cover, and an inner liner that provides a path for very high gas velocities to wipe the heat away from the inner cover, and a heat exchanger means in the form of convector plates to pass all the gases across the coil edges and heat these coils from the edges rather than through the laminations. The movement of this gas requires a very high capacity, high pressure fan installed in the base which, in these furnaces, moves approximately 8000 to 10,000 CFM of gas at 10-inch total pressure.

★ ★ ★

Earlier forms of circulating fans simply blew the gases towards the inner cover, but subsequent development work devised a type of diffuser more or less as shown in Fig. No. 2, which converted the velocity pressure of the gases to static pressure with approximately 50 per cent increase in efficiency over that obtained by just blowing the gases into an open area.

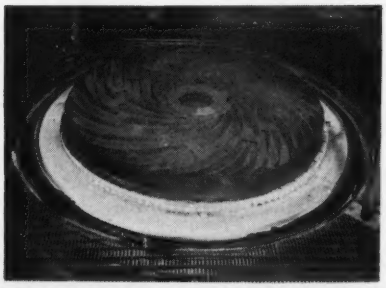

Figure 2.—Charge support and diffuser assembly for 108" diameter base.

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The results of this combination created a new conception in the annealing of steel coils that increased the productivity of each charge pedestal by 2½ times and made practical the annealing of steel coils up to 72 inches in diameter. The sizes of these furnaces followed the sizes of the coils to be annealed, so that many units of this type are operating for a charge size of 72 inches in diameter by 162 inches high, with charges up to 75 tons of material.

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While the rapid expansion of the flat sheet industry put a great deal more pressure on the development of equipment for it than did some other industry, it was entirely logical that what had been developed for annealing steel strip coils should be applied to annealing any other materials that could be loaded in a bell-type furnace. The wire industry offered the best opportunity to work in, and several years ago early experimental installations were made to determine the method, design, and results that could be obtained with this system in annealing wire.

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The first installations of this kind followed the details of steel coil design too closely and it was found that (1) wire coils are more easily heated by radiation than they are by convection, and that if an inner liner was used in the inner cover, it only offered a block against radiation heat transfer, and therefore for wire annealing, it was decided to omit the inner liner and circulate the gases directly over the coils.

(2) The diffuser assembly for wire does not require top cover plates such as are used for steel coil annealing, and these are omitted so that the gas circulation was not confined to a narrow, high velocity chamber before the gases arrived at the top of the inner cover. By placing the wire spiders with their charge directly on an open-type diffuser, the gases can move any way that is possible, as shown on Fig. 3 of Drawing 13092-A. The direct delivery of the fan produces an aspirating effect at the bottom of each spider so that the direct fan delivery induces secondary gas flow down the center of the spiders, particularly on bases that have several spiders to make up the load, as compared to having a single-stem load with a fan moving gases directly down the spider.

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(3) The fan volumes for this type of installation were increased, while the actual pressures were decreased. This permitted the use of a much higher volume fan, and, of course, the lowered resistance in the furnace system meant that the fan drives had to be increased in power to take care of this larger gas movement; and in successive steps from the small furnaces to the larger ones, these fan drive applications vary from 7½, 10, 15, and 25 horsepower.

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(4) The wire annealing furnace is limited in height by the permissible weight of the charge in the bottom to avoid sticking of the coils during annealing; and for this reason, wire charges have not exceeded 84 to 90 inches high, although some new installations for rod annealing are under consideration for 108-inch piling height. Wire annealing furnaces have been sized according to a combination of coil diameters, so that a 62-inch furnace could accommodate three stems of wire drawn on a 22-inch block, while a 74-inch base could take care of four stems of this size. For rod coil annealing, most furnaces have been equipped to handle only one stem of rod coils, but the improvement in heat application and the possibility of getting the required circulation in several stems of rod coils of one charge made it possible to consider a much larger furnace for rod and wire than had hitherto been developed. Three stems of rods can be placed within a 108-inch circle, and that was the size of furnace determined where there was sufficient tonnage of either rods or wire to warrant a furnace which could charge 18,000 pounds of rods or 36,000 pounds of wire.

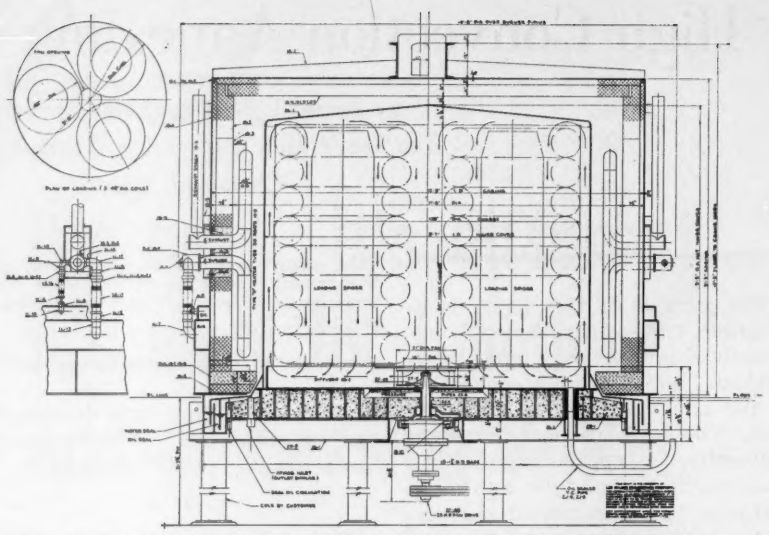

Figure 3.—Cross section of furnace and base assembly for 108" dia. x 84" high charge. * *

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(5) For heating charges where the total area exposed to radiation for the given weight was very large, such as is available in a coil of wire, smaller radiant tubes and more of them were thought to be better for heat application than the larger tubes that are used in the steel coil furnaces. Therefore 4½-inch diameter tubes were decided upon and installed in quantities per the following table:

Charge Diameter	Fan Capacity	No. of Radiant Tubes	Total Input
48"	7½ HP	8	2,000,000 Btu/Hr.
62"	15 HP	10	2,500,000 Btu/Hr.
74"	20 HP	12	3,000,000 Btu/Hr.
108"	25 HP	20	5,000,000 Btu/Hr.

The presentation up to this point has been the background of the development of the equipment. The details of design are now presented as shown on Fig. No. 3. This is a cross section of a 108-inch by 84-inch high convection annealing furnace showing the general construction of the furnace and the arrangement of furnace, base, and inner cover. The design of the O-type radiant tube is worth a brief description. These tubes are fabricated from wrought material, and the elbows are stamped out and put together in the form of a torus so that they can be sawed to 180-degree elbows or 90-degree elbows, as required. (See Fig. 4—"0" tubes.) A dual pressure nozzle mixing burner is applied to each tube, which delivers air in primary and secondary quantities. (See Fig. 5.) Combustion of the gases takes place throughout most of the length of the tube and varies but little throughout the range of 10 to 1 turndown, so that the releasing area is practically constant and no part of the tube is overloaded. In the design of the burner, the amount of primary air is approximately 25 per cent, and the secondary air, 75 per cent. These quantities are not subject to variation in the use of the equipment but are determined by orifice design for each furnace. Fig. No. 6 is what is seen when looking up on the inside of a furnace equipped with these tubes. In effect, each

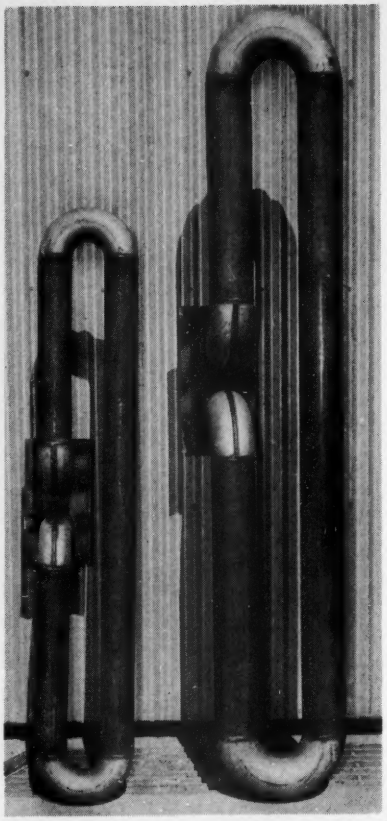

Figure 4.—"O" type radiant tubes 4-½" dia. and 6" dia. sizes.

tube has two vertical heating legs so that a furnace with 20 tubes has really 40 vertical radiant tubes applying heat to the inner cover surface.

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The diffuser or charge support assembly can be examined in some detail. (See Fig. 7.) The impeller-type recirculating fan is mounted in the middle of this assembly and a number of diffuser vanes are located from the edge of the fan wheel to the periphery of the assembly to expand the gases gradually and efficiently. The tip of these diffusers is an alloy casting placed in a very definite angle tangent to the fan clearance circle. The position and angle of the tip are critical because the variation of a few degrees can change the fan delivery by as much as 50 per cent. These structures are made strong enough to carry the load and keep the vanes rigid. The diffusers are made either of mild steel or alloy, in accordance with the type of service and temperatures involved. Returning to Fig. No. 3, the base construction can be examined. The base refractories are usually installed of a castable material of high insulating value. Under the diffuser assembly there is a series of corrugated alloy rings which carry the weight of the charge down into the base frame. The refractory is only a stiffener and does not carry the load, and therefore will last almost indefinitely. The exterior of the base has an oil and water seal ring in which the inner covers are sealed.

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The fan drive used in the base is a unique design which has been tested in over 300 annealing bases. Fig. No. 8 shows the details of this fan drive which provides a top bearing continuously lubricated with filtered oil which flows by gravity from an overhead storage tank. The shaft has a very adequate seal on it to prevent any gas leakage, but the area above the seal is entirely pressurized by the indicated pressure pipes so that at maximum temperature there is plus ½-inch pressure above the seal. The fan drive is powered with V-belts from motors of the required size, except in case of the 7½ HP size, for which integral

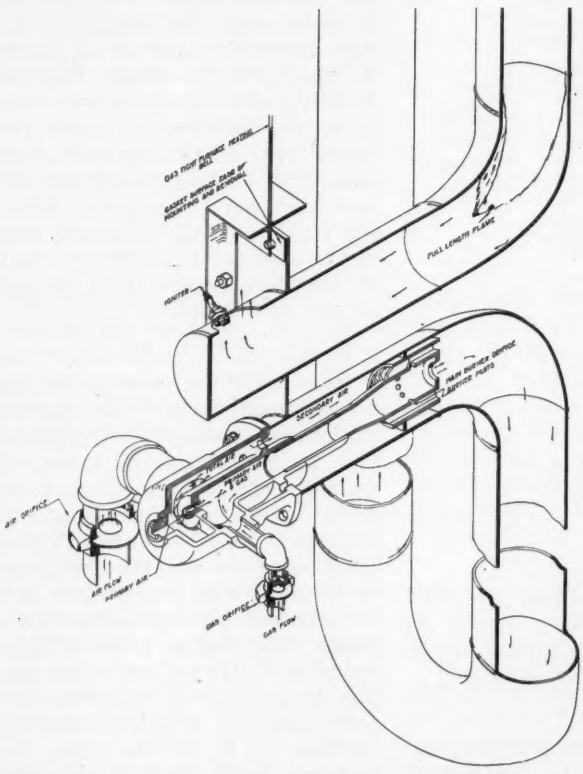

Figure 5.—Cutaway view of "O" tube with dual pressure burner.

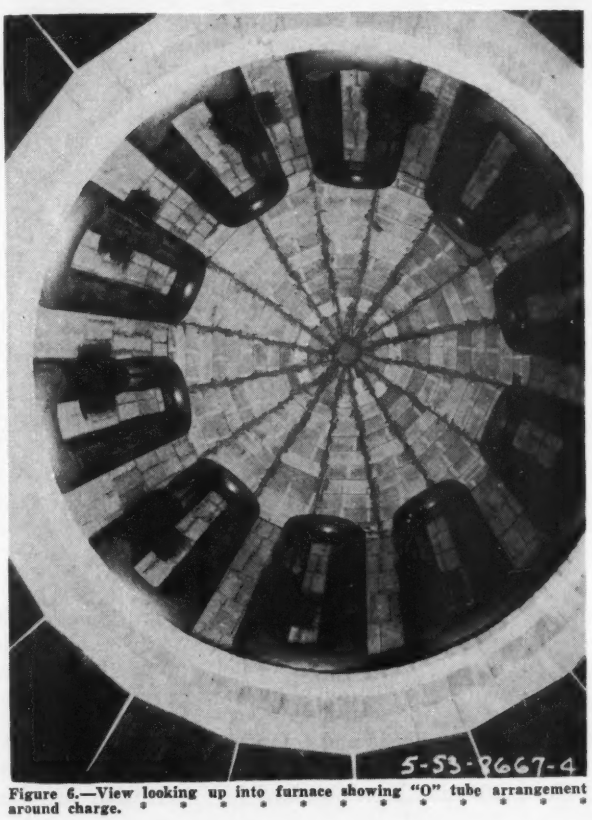

Figure 6.—View looking up into furnace showing "O" tube arrangement around charge.

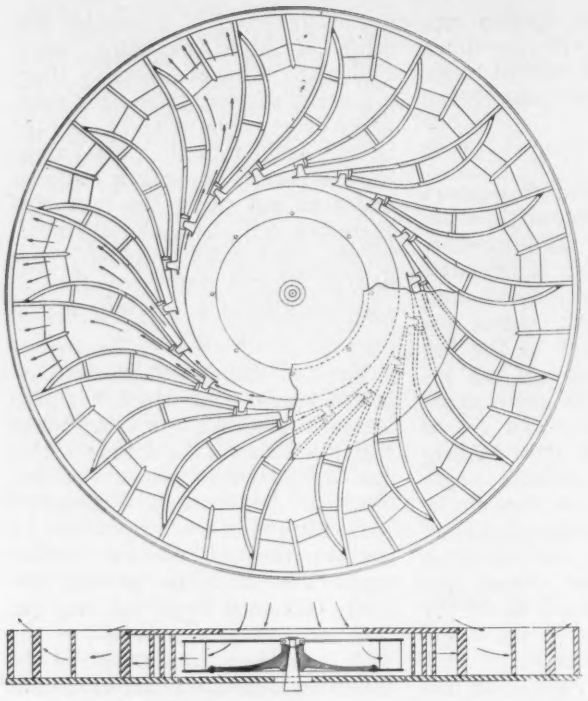

Figure 7.—Details of diffuser assembly construction.

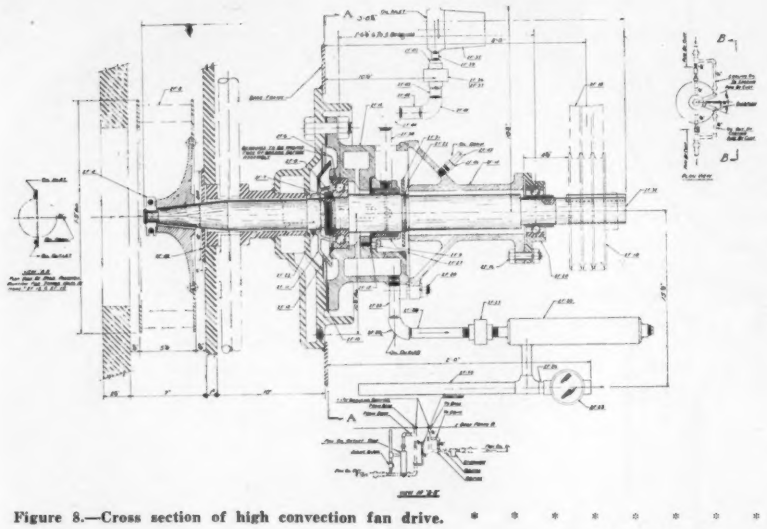

Figure 8.—Cross section of high convection fan drive.

motors are now available.

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The fan wheels are made of different high-temperature alloys according to the speeds and temperatures involved. Satisfactory fan performance has been obtained for operating temperatures of 1650 degrees with an alloy known as 20-20-20, the percentages of nickel, chromium, and cobalt contained.

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While much of the foregoing description has been in the line of

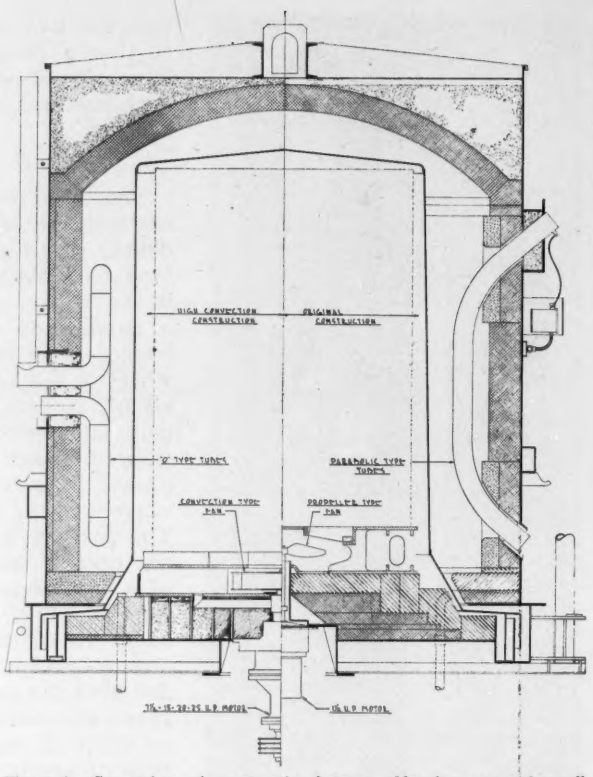

Figure 9.—Comparison of construction between older furnaces with small fans and parabolic type heating tubes and the high convection units.

new furnaces of new design, it will be gratifying for the wire industry to know that their existing furnaces could be rebuilt to this new design for sizes of 48 inches, 62 inches, or 74 inches. Fig. No. 9 shows the comparison of construction between the older furnaces with small fans and parabolic-type heating tubes and the new high convection units. Existing piping, wiring, and steel work can be used and the exchange made at considerably less than the cost of new equipment.

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Now as to the results that can be obtained from this type of equipment, some general and specific comments can be made. In general, time to temperature can be cut in half, as compared to older equipment. For rod spheroidizing operations, three stems of rods can be treated in no longer time than is required for operation on a single stem and at a lower initial investment. On process or low carbon wire annealing, the yields from these furnaces for given sizes will increase 40 to 60 per cent. For instance on a 74-inch diameter

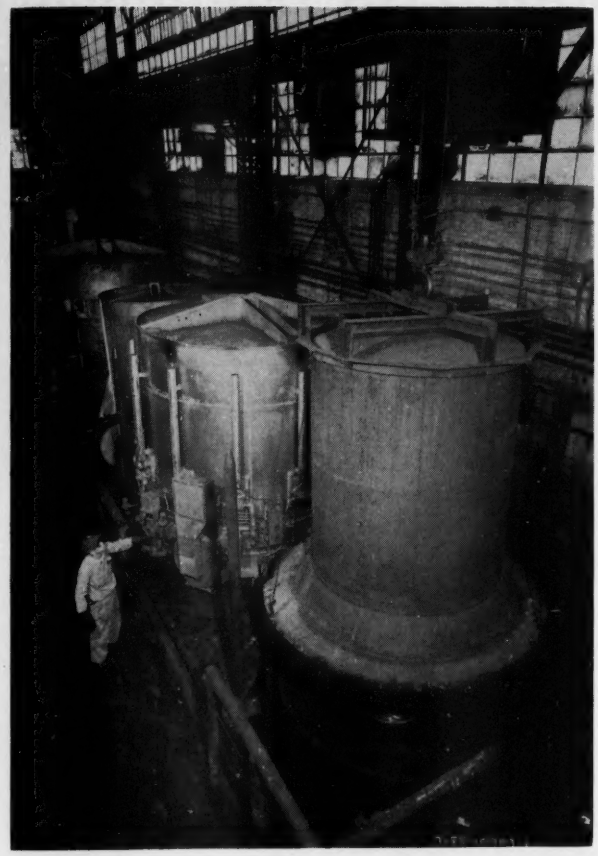

Figure 10.—74"x84" furnace which was converted to high convection design.

Figure 11.—Installation of three 108"x84" furnaces with 5 bases for rod coil spheroidizing.

Figure 12.—Installation of 2 furnaces and 6 bases, charge size 108" dia. x 90" high, for rod coil spheroidizing and process annealing.

furnace which produced 2000 pounds per hour of low carbon wire annealing, the yield went up to 3600 pounds per hour on the high convection type. (See Fig. No. 10.)

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On the 108-inch diameter furnaces where the charge can be in the neighborhood of 20 tons, production rates of more than 4000 pounds per hour have been obtained. All of this has been accomplished with a reduction in fuel input of at least 15 per cent, and, of course, without the utilization of any more floor space. This new equipment offers a tremendous step forward in productive possibilities, with uniformity of physical properties and metallurgical structure to meet all required specifications at these high rates of production. (See Figs. 11 and 12)

★ ★ ★

The wire industry has a useful, new tool available for expansion of its facilities and for the replacement of many of the older wire annealing units which are now outmoded in design but which have given many years of good performance that paid off the original investment a number of years ago.

★ ★ ★

In an industry which is as progressive as the wire industry, it is to be safely assumed that they will make adequate use of this new facility.

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Accelerated Heat Aging of Polyethylene

by

S. P. Foster
Research Division

and

W. W. Spohn
Sales Development & Service

Polychemicals Department
E. I. du Pont de Nemours and Company
Wilmington, Delaware

Polyethylene is now established as a versatile material for wire and cable jacket and insulation. Because of the exceptional durability of this polymer, it is quite difficult to find suitable aging tests for it. We will discuss here recent studies in accelerated heat aging of polyethylene.

★ ★ ★

The circulating air oven aging test, formerly used for accelerating the oxidative degradation of rubber insulation, is one of the methods of characterization sometimes used. For example, it now appears in an IPCEA specification for service drop wire. This test requires that polyethylene retains 75% of its elongation after 48 hours aging at 100°C., using a tensile specimen draw rate of 20 in./min.

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In our work one set of samples containing the normal amount of antioxidant and another set containing no antioxidant were subjected to this test. The results are shown in Figure 1.

Polyethylene of high crystallinity is known to be superior for wire and cable applications. This paper discusses recent studies which show accelerated heat aging improves polyethylene compounds for wire and cable by increasing the crystalline content. It was prepared for presentation at the Annual Convention of The Wire Association in Chicago, November 14-17, 1955.

Mr. Foster received his B.Ch.E. from Yale University in 1945, and his M.S. from the University of Delaware in 1948. He joined the du Pont Company research organization in 1947. Recent work has been concerned with polyethylene research and development.

Mr. Spohn attended Oklahoma A&M College, receiving his B.S. in chemical engineering in 1947, and M.S. in 1948. After six years in research and manufacturing with the du Pont Company, recent work has been concerned with development work in "Alathon" polyethylene for wire and cable applications.

The elongation and tensile strength in each set of samples dropped an equivalent amount. These results could mean one of two things: (1) the antioxidant is not effective; (2) the test does not measure oxidative degradation. The antioxidant used was diphenyl p-phenylenediamine. There is overwhelming evidence of its effectiveness from long practical use.

Continuing the tests, two sets of samples were aged for 48 hours at 100°C. and then remolded, to find out if the change in properties was reversible. Table 1 contains the data from these tests.

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It is evident from these data that the loss in elongation is reversible, and can be fully recovered by remolding. If the polyethylene had undergone oxidative degradation, remolding would not have reversed the process. The only conclusion that can be drawn from these tests is that the change in properties of the polyethylene is not due to oxidative degradation.

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To substantiate these findings, we aged samples of polyethylene at temperatures higher than 100°C. Table 2 shows the effect of aging at 100°C., 105°C., 115°C., and 120°C. The higher elongation obtained at 120°C. is a result of aging the polymer above the crystalline melting point.

Figure 1.—EFFECT OF ACCELERATED AGING ON POLYETHYLENE ELONGATION AND TENSILE STRENGTH
% Elongation (Draw Rate 20"/min.) and Tensile Strength (psi) Vs. Hours Accelerated Oven Aging at 100°C.

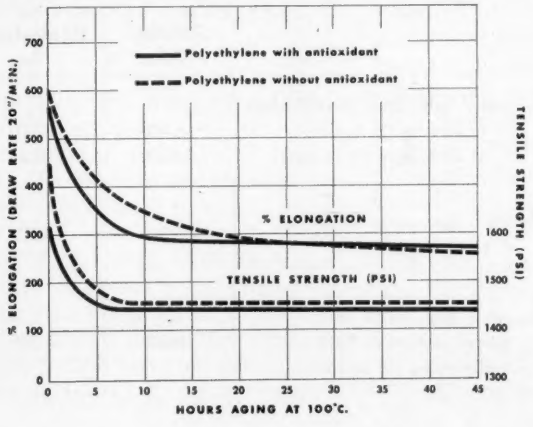
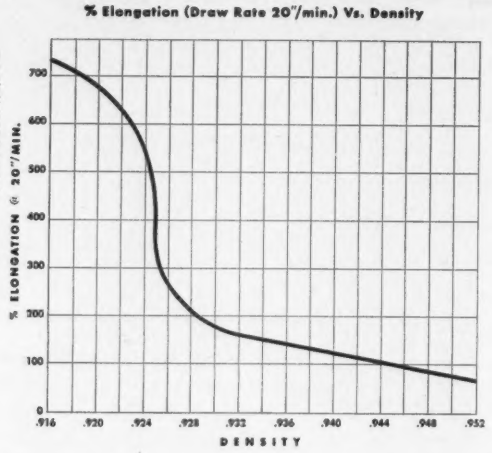


Table 1

THE REVERSIBILITY OF LOSS IN ELONGATION OF POLYETHYLENE WITH ACCELERATED AGING

Exposure	0 Hr.	48 hr. at 100°C.	48 hr. at 100°C. Remolded Samples
Elongation (%) (Draw rate 20"/min.)	570	280	580
Tensile (psi)	1620	1450	1670
Density	0.922	0.926	0.922

Figure 2.—CORRELATION OF POLYETHYLENE DENSITY AND ELONGATION



Sperati et al[1] showed that elongation is dependent on the crystallinity of the polyethylene and that density of the polymer reflects the degree of crystallinity. Figure 2 shows a correlation between density and elongation, draw rate of the tensile specimens being 20 in./min.

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The higher the density, the higher is the yield strength of the polymer. The work required to draw a polymer increases with an increase in density. Therefore, the temperature rise during drawing is greater with the higher density polymers. We have calcutated that this temperature rise for a 0.923 density polymer should be roughly 35°C. for a rapid rate of strain where heat loss is negligible. A 0.914 density polymer should have a comparable temperature rise of 25°C.

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The apparent drop-off in elongation of polyethylene after accelerated aging can be explained by the fact that the higher level of crystallinity (and therefore higher yield strength) after thermal aging results in a greater temperature rise within the tensile specimen during the elongation test. This temperature rise is sufficient to reduce the tensile strength below the yield strength of the undrawn portion of the test bar. Thus the tensile specimens break off before reaching their maximum elongation.

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Table 2

ACCELERATED AGING OF POLYETHYLENE FOR 48 HOURS AT VARIOUS TEMPERATURES

	Tensile Strength psi	Elongation %
No aging	1620	570
100°C.	1450	280
105°C.	1450	220
115°C.	1345	190
120°C.	1620	330

To confirm that the drop-off in elongation of a high density polymer with accelerated aging could be explained by thermal effects, the following experiments were carried out.

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Samples of polyethylene, after accelerated heat aging, were drawn at 20 in./min. and 2 in./min. Samples of the same polymer were drawn at 20 in./min. but sprayed with water during drawing. Results of these tests, as shown in Table 3, confirm the theory that the decrease in elongation is due to thermal effects.

★ ★ ★

By drawing the specimen at the slower rate, less heat is generated within the polymer because less work is required to draw the specimen. Elongations of aged and un-

Figure 3.—THE EFFECT OF DENSITY ON THE ABRASION RESISTANCE OF POLYETHYLENE WIRE COATINGS (MELT INDEX 1.6) USING THE MODIFIED GENERAL ELECTRIC SCRAPE ABRADER

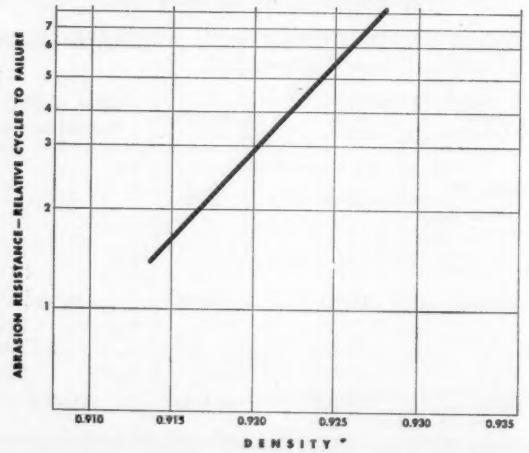


Table 3

POLYETHYLENE TENSILE MEASUREMENTS MADE UNDER ISOTHERMAL STRAINING CONDITIONS

	Tensile psi	Elongation %
1. Control Tests—Strain Rate 20 in./min.		
a) No aging (20 in./min.)	1620	570
b) 100°C. aging (20 in./min.)	1430	183
2. 100°C. aging, except sample drawn at 2 in./min.	1500	550
3. 100°C. aging, except water sprayed on samples during tensile testing. (20 in./min.)	1600	400

aged samples were almost equal, (570% no aging at 20 in./min. vs. 550% 100°C. aging at 2 in./min.). Comparable results were obtained when spraying the specimen with water to remove the heat of drawing at 20 in./min.

★ ★ ★

To determine the effect of oven aging on low temperature toughness, polyethylene coated wires were put through several "torture" tests after oven aging at 100°C. These included bending, flexing, wrapping on a 90-mil mandrel, and impact tests. We were unable to promote a single failure in the insulations. Table 4 shows results from the mandrel wrap tests.

wire coating was allowed to come to equilibrium at -60°C. The sample was then bent rapidly through 180°. This stimulates a mandrel wrap test in which the mandrel has a diameter of zero. Results were the same as for the first test: no breaks in the unaged sample or in the samples aged for 64 hours at 100°C.

★ ★ ★

We conclude from these experiments that the loss in elongation with accelerated aging has no significance with respect to the actual performance of polyethylene wire coatings.

★ ★ ★

We have shown above (Figure 2) that heat aging increases density (crystallinity). Burrough et al[2] showed that higher crystallinity gives greater toughness. As one measure of toughness, tests were performed using a modified General Electric Abrader. (A flat blade was substituted for the needle, which was designed for magnet wire.) Figure 3 shows a plot of density vs. abrasion resistance, in cycles to failure.

★ ★ ★

In this plot, there is a marked increase in abrasion resistance with increased density.

★ ★ ★

Another property directly related to density is Vicat temperature, as shown by Sperati et al[1]. Figure 4 is a plot of Vicat temperature vs. density. The Vicat temperature is used instead of Randall-Stickney, because of the greater precision of the Vicat test. However, both tests measure heat distortion and correlate well with each other.

★ ★ ★

Since heat aging increases the density of a polymer, depending on the temperature and length of time, the toughness of the polyethylene is increased, as evidenced by abrasion resistance and Vicat temperature.

★ ★ ★

To determine the effect of a test similar to that specified in ASTM, we milled weatherproof samples of "Alathon"* with and without antioxidant, for six hours at 160°C. The dissipation factor or dielectric constant did not go up in either case.

★ ★ ★

The question now arises: Is a test really needed to determine oxidative degradation of polyethylene weatherproof wire coverings? We have actually found it hard to cause oxidative degradation of polyethylene in a simple laboratory test. Polyethylene can be degraded at extrusion temperatures, yielding a product poor in electrical and physical properties. There is some evidence pointing toward reduced weather resistance when no antioxidant is used. We know of no quick

(*Please turn to page* 1532)

Figure 4.—VICAT TEMPERATURE (°C.) VS. DENSITY FOR 1.6 MELT INDEX POLYETHYLENE RESINS

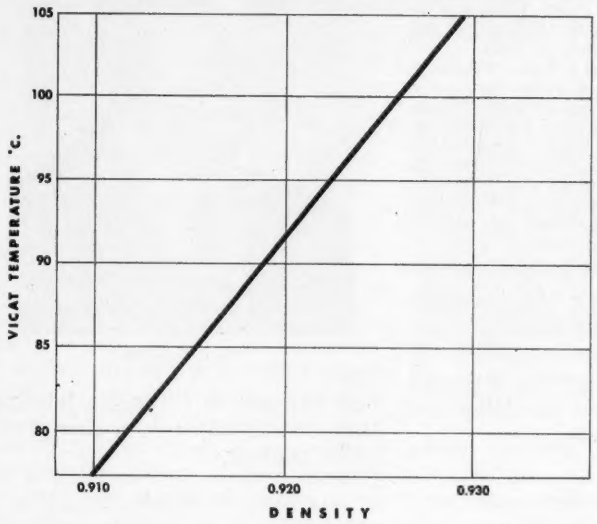


Table 4

POLYETHYLENE MANDREL WRAP EXPERIMENTS

Procedure—Chilled wire (copper + coating) to desired temperature and then wrapped around 90 mil mandrel at ca. 50 RPM.
Polymer —Density - 0.923

Conditioning	Temperature of wrap	Number of breaks per number of turns
No aging	23°C.	0 breaks/20 turns
48 hr./100°C.	23°C.	0/20
No aging	-60°C.	0/20
48 hr./100°C.	-60°C.	0/20
64 hr./100°C.	-60°C.	0/20

These data show the results of tests at room temperature and -60°C., with no aging, 48 hr. aging and 64 hr. aging at 100°C. There were no breaks or cracks, in any of the samples.

★ ★ ★

To make the durability testing more rugged, tests were run on the wire coatings free of the copper wire. A knot was tied loosely in a wire coating which was then placed in a -60°C. cold box. The knot was pulled taut at 20 in./min. The drawing was continued until the samples elongated. We experienced no breaks either with the unaged sample or the samples aged for 64 hours at 100°C. In another test, a

Advantages of Phosphate Coatings in Fastener Forming

by
John H. Geyer, Manager Development Division
and
Hugh Gehman, Assistant Manager
American Chemical Paint Company
Ambler, Pennsylvania

John H. Geyer

This paper was prepared for presentation at the Annual Convention of The Wire Association in Chicago, November 14-17, 1955.

Mr. Geyer graduated from Lehigh University in 1949 with a B.S. in Metallurgical Engineering. He worked for the Aluminum Company of America for a year and a half before joining the American Chemical Paint Company in 1951. He was appointed Manager of the Metal Working Division in 1953.

Mr. Gehman graduated from Princeton University in 1942, where he received a degree of B.A. in Chemistry. Before joining the United States Air Force he worked for Rohm and Haas in Philadelphia for one and one half years. In December, 1945, he joined the American Chemical Paint Company and has since worked in the Agricultural as well as the Metal Working Division.

Hugh Gehman

Acknowledgements

Before entering the discussion of the subject at hand, the authors would like to make grateful acknowledgement to the **Russell, Burdsall and Ward Bolt and Nut Company** of Port Chester, N. Y. Most of the work reported here was performed in their Port Chester plant and would have been impossible without their assistance. In addition, we would like to express our appreciation to many individuals at Russell, Burdsall & Ward at Port Chester, N. Y., Coraopolis, Pennsylvania, and Rock Falls, Illinois, but particularly to **Mr. R. A. Mac Donald, Mr. Paul Polonec and Mr. Joseph De Markey,** who contributed so much with their wide experience and generous help.

★ ★ ★

We also thank the management of our own company, the **American Chemical Paint Company,** for permission and encouragement to make this report and The Wire Association itself for providing the occasion and the forum.

Introduction

We need not dwell on the many types of cold forming steel in which zinc phosphate coatings play a significant part. They are widely used to cold draw tubing, both seamless and welded. They protect the polished surfaces of bumper blanks as they are pressed prior to plating. The extensive cold drawn steel cartridge case program instituted by our government after the Second World War utilized zinc phosphate coating in almost every installation. And many of you in the wire mills, particularly those who draw wire for rope, are familiar with the operation and advantages of these coatings in your plants. In addition, the cold extrusion of many types of steel and many shapes is well-nigh impossible without a lubrication system based on a zinc phosphate coating.

★ ★ ★

It was the lessons and experience gained in the new field of extruding cold steel which led us to question what value, if any, our zinc phosphate coatings might have in the manufacture of fasteners. As you know, producers of cold headed steel fasteners employ a number of methods of moving the metal, including extrusion. Most or all of these methods involve the work moving along the surface of the tool and it is natural to expect considerable pressure, heat, and friction, particularly at the high production rates of modern cold headers, bolt makers, and nut formers. We felt certain that there was a place for our coatings in these circumstances and deter-

mined to find out wnere.

★ ★ ★

At about the same time, certain people at Russell, Burdsall & Ward had decided that they needed an improved lubrication system to assist in accomplishing some of the newer and more difficult forming jobs they were designing for their customers. They, too, were anxious to know if phosphate coatings would make these difficult jobs practical. The result was a cooperative development program begun in August 1954 and still continuing. We are setting forward the results of more than fifteen months of production experience on a wide variety of nuts, bolts, rivets and screws.

★ ★ ★

In the cold forming of steel, the zinc phosphate coating serves two primary purposes. First, being an inorganic crystalline coating chemically bound to the metal, it becomes an excellent separating layer, capable of withstanding extreme pressure and yet maintaining continuity. It strongly resists the formation of welds between tool and work. Even after severe deformation of the metal at high speed, the film of phosphate crystals remains unbroken. Secondly, the coating acts as host or carrier for the lubricant, generally a soapy material, holding more of it and holding it more tenaciously. It is thought that there is a chemical interaction between zinc phosphate coating and lubricant resulting in an even tighter, closer bond between the two. Such a bond may help to account for the extreme adherence and tenacity of phosphate-lubricant systems.

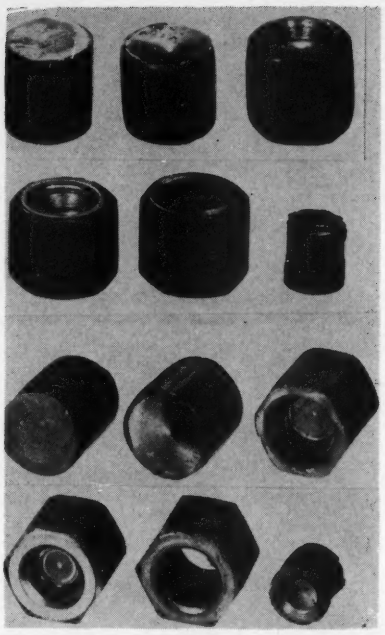


Figure 2.—Two views of the steps in producing a hexagonal nut from true size rod. * * *

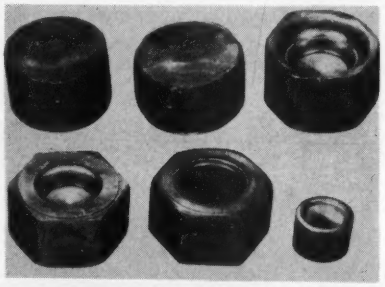


Figure 3.—Steps in the production of a hexagonal nut different from that shown in Figure 1. *

The two functions performed by phosphate coatings have very definite effects on production in cold forming operations. The property of providing excellent resistance to extreme pressure results in:

(1) greater speed of draw where possible.
(2) greater reductions within the physical limits of the metal.
(3) more passes with the same number of intermediate treatments.
(4) possibility of fewer process anneals.

★ ★ ★

The second property, that of good separation and surface protection, directly results in:

(1) extension of the tool life.
(2) less "out of production" time on machines.
(3) a better surface on the finished product.

Procedure

The phosphating of rod prior to forming fasteners is simple and requires very little more time than does the application of more conventional lubricants. Figure 1 graphically illustrates the processing sequence. Rod, up to two tons per stem, is pickled in dilute sulfuric acid containing an acid inhibitor. After warm water rinsing, followed by a rinse in a pressure spray, the work is immersed in the zinc phosphate coating bath for three to six minutes. The bath is maintained at about 160°F to 170°F and at a strength of about 20 points (pointage is defined as the number of ml. of O.1n NaOH required to neutralize a 10 ml. sample of bath to the color change of phenolphthalein indicator). The coils are then rinsed in the pressure spray and here the operation varies with the particular stock in question.

★ ★ ★

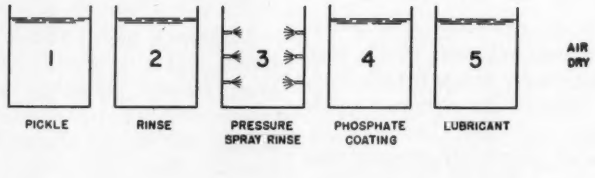
If it is scrapless nut stock, it is immediately immersed in a lubricant solution consisting largely of high titre soap, after which the lubricant is allowed to dry. The heat absorbed by the rod in the lubricant tank is, in most cases, sufficient to dry the soap completely in a few minutes. The rod is then fed into the multiple operations of the nut former.

★ ★ ★

If the stock is for bolts, screws,

FLOW SHEET

PHOSPHATING & LUBRICATING PROCESS SEQUENCE ON ROD FOR VARIOUS FASTENERS



NUT STOCK SEQUENCE - STAGE N°1, N°2, N°3, N°4, N°5 - AIR DRY

BOLT, SCREW & RIVET STOCK SEQUENCE - STAGE N°1, N°2, N°3, N°4, N°5 - AIR DRY

Figure 1. * * * * * * * * * * * * * *

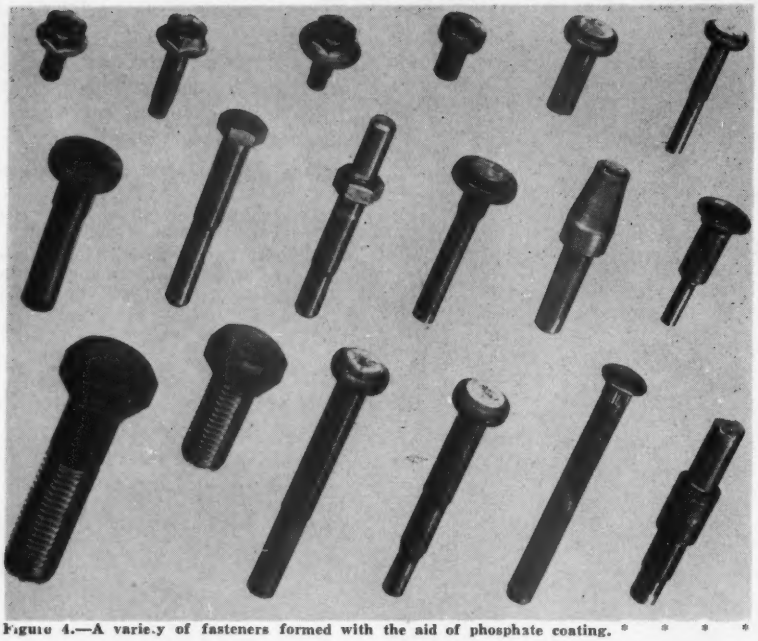


Figure 4.—A variety of fasteners formed with the aid of phosphate coating. * * * *

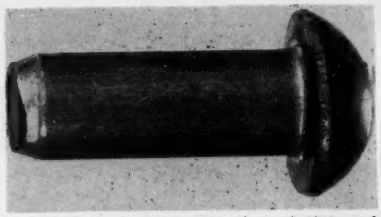


Figure 5.—Standard 3/8 inch rivet of 1010 steel.

Because of closer tolerances, this type of rod need not be drawn to size prior to nut forming. In addition, it may be purchased in much larger coils than ordinary rod and therefore the necessity of welding coils together is eliminated.

★ ★ ★

If true size rod could be formed satisfactorily, two operations; welding of small coils and drawing the welded coil, as well as all the material handling and labor necessary to accomplish these operations, would be eliminated. It was soon found that phosphating and immersion lubricating of the nut stock produced better forming results, less tool trouble, and a better finished surface than any other lubrication system tried.

or rivets, the phosphated rod is merely rinsed and allowed to dry, again by means of its absorbed heat. After welding the ends of several coils together, the rod is given a single pass 12 - 15% reduction at low speed, using conventional mixtures of lime and soap powder in the die box. The drawn rod is then placed on a reel and fed into a conventional header or bolt maker.

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In certain cases, stock for bolts, screws or rivets has been phosphated and lubricated in the pickle line. One further point should be made. It is recommended practice in phosphating for cold forming to include a hot neutralizing rinse between the phosphate and the lubricant baths or as the final rinse after phosphating only. Such a rinse protects the lubricant from drag-in of acid salts from the phosphating bath. Where phosphated rod is to be dried without lubrication it insures that the rod will not blush rust during drying. Due to space limitations and high production requirements no such neutralizing rinse was used during the work reported here. However, we have observed no detrimental effects due to the absence of this refinement. Blush rusting is only an occasional occurrence and the original lubricant tank remained in service for over a year without being discarded.

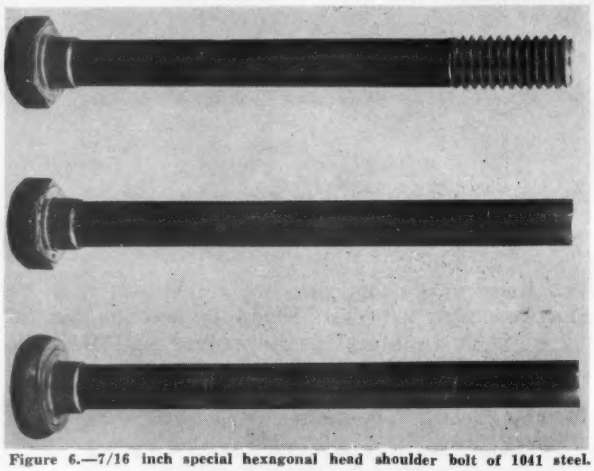

Figure 6.—7/16 inch special hexagonal head shoulder bolt of 1041 steel.

Results

A. Nut Forming

Prior to the installation of phosphate coating, all nut stock was pickled, limed, or given a sull coat, welded, drawn to proper size through one hole and then formed. Attempts to eliminate operations, handling, and labor, thereby reducing costs, resulted in the purchase of scrapless nut stock or what is called "true size rod."

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Figures 2 and 3 show two of the hexagonal nuts produced from the true size rod, phosphate coated and immersion lubricated. On the extreme left is the sheared rod, and second from the left, the sized slug. Next come the two piercing operations followed by the finished nut and knockout piece on the extreme right.

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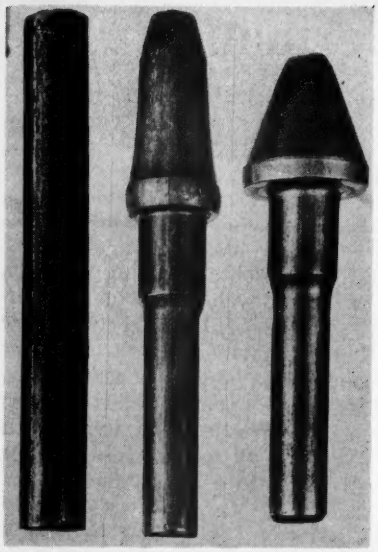

Figure 7.—½ inch automotive hood bolt of 1010 steel, showing sheared rod, preformed part, and final heading. * * * * * * *

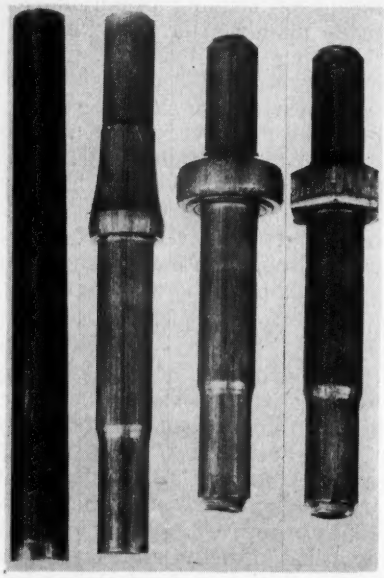

Figure 8.—3/8 inch special upset bolt of 1038 steel, showing sheared rod, extrusions, preheading, and hex headed component. * * * *

Figure 9.—0.338 inch hexagonal washer head shoulder bolt, showing sheared rod, first extrusion, preheaded, and finished pieces. * * *

CARBIDE TOOL LIFE ON CERTAIN BOLTS
(USING CONVENTIONAL LUBRICANTS)

	JOB	STEEL	HIGHEST NUMBER OF PIECES PER DIE	AVERAGE NUMBER OF PIECES PER DIE
7/16	SPECIAL HEX HEAD SHOULDER BOLT	1041	570,000	292,000
1/4	BY 2 LAG BOLT	1018	730,000	397,000
1/4	BY 1½ LAG BOLT	1018	695,000	270,000

Figure 10. * * * * * * * * * * * * * * * * *

Tool life studies are being conducted on these nut formers and at the moment insufficient data has been collected for us to know what the tool life actually is and how it compares with the tool life using other methods of lubrication. The present indication is that tool life is extended over that expected from lime or die box lubricants. The combination of extended tool life, less "out of production" time on expensive machines, (bolt makers may be charged to the department in which they operate at rates of $10 to $25 per hour for time during which they are shut down), and a better finished product seems to overshadow completely the slight extra cost of true size rod and the cost of phosphating and lubricating it.

B. Bolts, Rivets and Screws

At the outset of the investigation involving bolts, rivets, and screws, work was confined almost completely to jobs known to be extremely difficult, to specialty jobs, or to newly designed jobs. (See Figure 4.) All of the early work selected for phosphate evaluation was work on which more conventional methods of lubrication had either failed or left much to be desired.

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In any investigation, it is encouraging to receive at least some good results at the start and we received almost more than our share. Two things almost immediately became apparent. First, the phosphate coating was assisting materially in solving some of the more difficult problems, the specialty items, and the new designs. Secondly, there was definite evidence that tool life could be extended considerably in a number of cases. More exhaustive investigating has further substantiated the early results and we should like to go into a little more detail at this point.

Special Benefits

One of the first items demonstrating a special benefit of phosphate coating occurred in making a 5/16 inch special round head rivet. This piece was made from 1010 steel using high carbon, high chrome tools with a carbide point. Difficulty had usually been experienced in filling out the point of this rivet using limed rod. Very little, if any, such difficulty arose during the manufacture of over two and one quarter million pieces using phosphate coating.

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A .343 inch hinge pin, with a spiral groove and knurled under the head, made from 1020 steel using a carbide die showed marked improvement in knurling and grooving characteristics when phosphating was used.

★ ★ ★

A 3/8 inch cap screw for the automotive industry made using the high carbon, high chrome tools from 1038 steel presented a problem every time it was manufactured because of its tendency toward poor swelling of the shoulder. Poor swelling had been caused by the necessity of using more oil to eliminate scoring. Upon receiving phosphated rod, the part was made without scoring and operating with less oil.

(*Please turn to page* 1528)

Wire Rod Descaling in Germany

by Dr. A. O. Koegel, Manager
Westfalische Drahtindustrie
Hamm (Westf.), Germany

1. Disadvantages of Chemical Descaling of Wire Rods

The necessary removal of the scale from the surface of the wire rods before the drawing operation is done today mainly by chemical means, namely, running the wire rods through sulphuric acid. This method, together with the increase in production, has caused serious pollution of our rivers, and, in fact, has endangered the entire water economy in some parts of Germany.

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Purification plants have been erected in some places for taking care of these spent acids. However, while theoretically it is possible to remove, let us say, 30 per cent of the contaminating substances in the form of ferrous sulphate (Fe SO4), in most cases, these plants are of very small practical value.

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The heavy iron and steel industry in Germany is concentrated in the Ruhr district. It is there that we find the large wire mills with their pickling plants. For this reason all wire mills in Germany are confronted with the problem of how and in which manner the spent pickling solutions and rinsing waters can be freed from the injurious and obnoxious ingredients. If this is to be done in a really thorough manner, then very high investment costs are required in addition to comparatively high operating costs.

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A great deal of thought has been given to this problem for many years, as well as serious consideration to how and by what other means the descaling of wire rods can be effected.

2. Development of Mechanical Descaling by Means of Bending

In Wire and Wire Products May, 1954, Page 507, it was reported that already as far back as 1893 suggestions had been made to descale wire rods by another method. Here the descaling method by bending has been mentioned for the first time. The method of descaling by means of bending, namely, the continuous bending of wire rods in different planes over rollers of determined diameters before entering the wire drawing machines, is so well-known in this circle of experts that I do not think it necessary to go into a more detailed explanation.

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A great deal of interest was shown for this new method in Europe since the middle of World War I because the sulphuric acid necessary for pickling was very difficult to obtain during war-time. Further development of descaling by means of bending took place then primarily in France. Definite conclusions were reached there in 1941 when the so-called "Gorcy" machine was put on the market. **Wire and Wire Products** reported this in detail in the August, 1950, issue.

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The development of descaling by means of bending began in Germany mainly after the year 1945. Descaling machines of different systems were tried and tested, however, nearly all of them were influenced by the "Gorcy" machine. My company, Westfälische Drahtindustrie, Hamm (Westf.), has carried out many experiments and has used and tested the "Gorcy" machine, an "Argentina" machine and machines of our own design.

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The principle of descaling by bending with all its physical prerequisites has been cleared up in the meantime by Eisenhuth. A detailed description has appeared in **Stahl und Eisen**, August, 1955, page 1093. Here Eisenhuth describes exactly the conditions under which a mechanical descaling of wire is possible, i.e., a beginning descaling can be said to occur with 4% elongation, a coarse descaling with 8% elongation and a fine descaling with 12% elongation. Also, the diameter of the bending rollers for every wire diameter is clearly indicated, which should enable anyone to build machines in accordance with their own requirements.

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In the development of descaling by means of bending, it soon was found that with bending over rollers of different diameters alone no perfect descaling could be attained, but that deposits of very fine dust-

Dr. Alfred O. Koegel

Dr. Koegel was born in 1896 and graduated from the Technical University of Hannover (Germany) in 1922. After several years with Messrs. Krupp Friedrich-Alfred-Hutte, Rheinhausen and Messrs. Klockner, Haspe, he returned for another 10 years to Friedrich-Alfred-Hutte. Since 1943 he has been Works Manager of the Westfälische Drahtindustrie.

The author prepared this paper for delivery before the Annual Convention of The Wire Association in Chicago, Illinois, November 14-17, 1955.

like scale remained on the wire.

★ ★ ★

During this time many different devices were made to remove this scale dust; rags, steel wool or the like were used for this purpose.

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"Gorcy" tried an additional cleansing with rotating brushes which not only turned around their own axis, but also around the axis of the wire. Still more intensive yet is a mechanism consisting of rotating wire brushes movably fastened to a rotating wheel which during each revolution hits the wire surface in a blow-like fashion. In the "Argentina" machine, the coarsely descaled rod is run through steel gravel in order to obtain the final cleansing. The last development attempts to obtain this final cleansing by means of magnetic postcleaning or by vibration, which is produced by means of electric induction current, as described in **Draht**, August, 1955, issue, page 325. The book **"Steel Wire"**, latest edition, 1952, by Pomp does not disclose any further facts about mechanical descaling.

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The success which was attained in descaling by means of bending was primarily obtained on single draft machines at slow speeds, and as long as no particular requirements were made in regard to surface. One disadvantage of descaling by means of bending remains; the use of soap as a drawing lubricant must be foregone with wires descaled by this method and, instead, the much more expensive special drawing compounds that have a stearate base must be used.

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In any case, a number of wire mills who produce only nail wire or wire for constructional steel netting have been successful in eliminating completely their pickling installations and actually were able to get along with mechanical descaling by means of bending. In spite of these partial successes, it was not possible to supplant the existing pickling plants in the larger wire mills with descaling by means of bending. It is a fact that up to present descaling by bending has **not** worked satisfactorily with high-speed multiple drawing machines having a final speed of about 1500-2000 ft/min. and in cases where special requirements as to the surface will have to be met. Whether we can expect success in this direction in the future must be left an open question since the effect of the various factors with respect to descaling by means of bending—namely, kind of the scale on the wire rod, type of drawing lubricant, and cleaning of the fine dust particles after breaking the scale — have not yet been clarified to the last detail.

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With the increase of the entire industrial production and, therefore, also the production of drawn wire in Germany after 1948, the problem of pollution of the waterways has in the meanwhile become so urgent that it is impossible to wait any longer for the results of these tests. Therefore, it was necessary to try to find a new way of mechanical wire descaling in order to reach the objective more quickly.

3. Descaling by Means of Shot-Blasting

These considerations necessarily directed the attention to the method of mechanical descaling by means of shot-blasting with cut-wire, since this method had already been employed with success for several years on steel strip, about which, for instance, M. Reimann, Wuppertal, has reported in detail. After it had been proved on steel strip that no disadvantages resulted from shot-blasting compared with the pickling method, only constructional difficulties were in the way to change to this method of descaling wire rods.

★ ★ ★

According to information given at the meeting of The Wire Association in October, 1951, it was known for many years to give a single wire a blast by means of the Wheelabrator. In the tests carried through at that time, however, it was intended to pass the blasted wire in addition through a pickling bath. Therefore a solution had to be found as regards the design which made it possible to carry a great number of wires simultaneously through the shot-blasting plant in order to obtain an economic operation in this way. As contrasted with the descaling method by bending which required the installation of an additional descaling device in front of each drawing machine, this method of passing several wires simultaneously through the shot-blasting unit appeared to be the only way leading to satisfactory results when descaling by shot-blasting, since otherwise the investment costs of

View of the Descaling-Department.

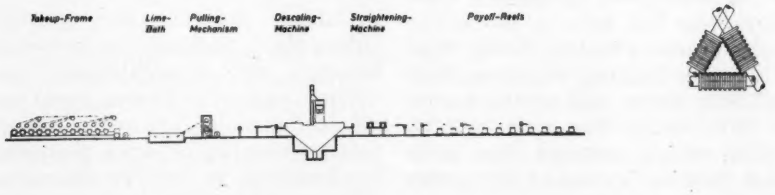

Figure 1

Scheme for Rod-guiding and Shot-blasting.

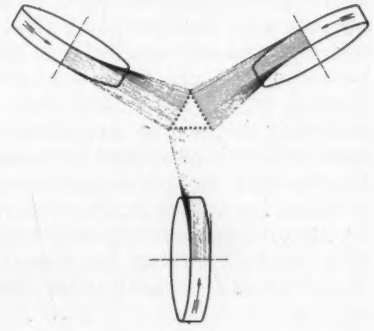

Figure 2

such a plant as well as the operating costs would have been far too high.

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On account of these considerations, my firm, the Westfälische Drahtindustrie, ordered in 1954 a shot-blasting plant for descaling wire rods from Messrs. Gutmann, Hamburg, who disposed of special experiences in that field — having obtained a first patent on blasting bars already in 1930. This first large plant enables the descaling of 24 wire rods at one time; it has been in operation for several months.

Description of the Plant

The plant is designed for descaling wire rods having diameters of about 1/5 to 4/5 of an inch. Depending upon the thickness of the rod, 6 to 24 wires can be shot-blasted at one time. The speed is about 40-60 ft/min. As may be seen from the figure No. 1, the rods are running from standard pay-off reels across a straightening machine into the shot-blasting unit. The shot-blast chamber has a base area of about 7 by 2 yards and a height of about 1.7 yards. It is made of steel plate and lined up internally with wear-resisting plastic material and soft steel plates. The bottom of the unit consists of perforated plate. Below the unit a collecting hopper is arranged to receive the abrasive and the scale. On one side there is a paternoster elevator for conveying the collected material. Adjoining this there is a wind separator for cleaning the abrasive from scale, rust, dust, etc.

The plant is equipped with 3 whirl blasters which are turned to each other by 120°. As may be seen from the figure No. 2, 8 wires each of 24 wires passing through are arranged in the shape of an equilateral triangle according to the arrangement of the whirl blasters. For a better and more precise adjustment as well as in order to obtain the optimum shot-blasting effect, the 3 whirl blasters are supported on rotatable chairs.

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Casing and cover of the blasters are protected against the destructive effect of the cut-wire shot by heavy armour plates. The shot-blasting wheel rotates with 2200 r.p.m. The cut-wire is fed to the 4 propelling blades of the shot-blasting wheel by its own weight. At the same time the cut-wire is accelerated by compressed air so that an almost shock-free transmission to the propelling blades will be obtained. On the propelling blades the cut-wire is accelerated further so that it is thrown on the wire rod with a velocity of 15,000 ft./min. Each shot-blasting wheel will be able to throw a maximum of 200 kgs/min., the driving capacity being 15 kw. According to the data given by Messrs. Gutmann the life of the propelling blades amounts to 1500 hours, that of the shot-blasting wheels to 8000 to 10000 hours and of the nozzle to 3000 hours. The wire will be guided safely through the shot-blast chamber by means of profiled rollers.

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As mentioned above, the wires are fed into the plant across a straightening machine. The installation of these straightening machines became necessary, because immediately after putting the plant into operation it showed up that the wire rod — being not straightened — frequently got superimposed and hence was not perfectly descaled on all sides of the surface. For that reason 3 straightening machines were installed in front of the plant for each of the three feeding sides. Since the takeup frame was not strong enough to be able to draw the rods through the straightening machines, a separate pulling mechanism was put between the shot-blasting plant and the takeup frame. Between the pulling mechanism and takeup frame a lime bath is installed. This bath can be used, of course, also for borax; quite as well a second bath could be placed for coating with copper or for bonderizing.

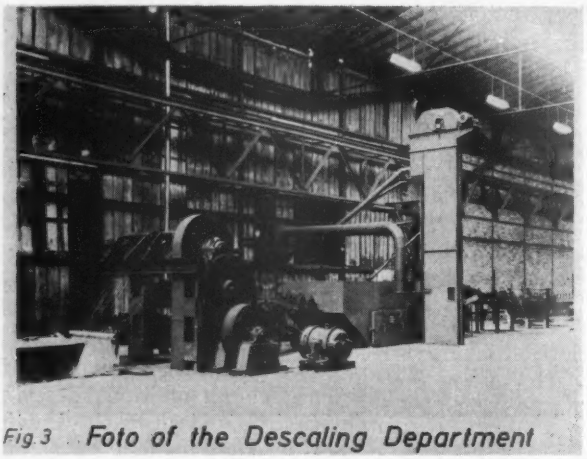

Fig. 3 Foto of the Descaling Department

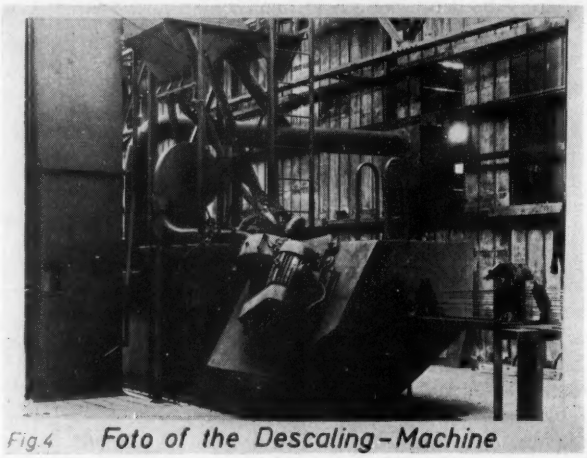

Fig. 4 Foto of the Descaling-Machine

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The cut-wire being used for blasting has a diameter and length of 0.4 mm, this means No. 28 ASWG, and a strength of 160/180 kgs/ square mm, i.e. 100/115 t/ inch^2.

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Guiding the wire through the entire plant, particularly, however, through the straightening machines, naturally causes breaking off of the scale. The plant, therefore, necessarily effects a descaling by bending, as well as by shot-blasting. This additional descaling by bending, however, can be taken

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Recent Developments In Polyethylene Insulating Materials

by

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This paper was prepared for delivery before The Wire Association at its Annual Convention in Chicago, November 14-17, 1955.

Mr. Lurie received a degree of B. Chem. Eng. in 1950 from M.I.T. and joined the Bakelite Development Laboratories in Bound Brook to engage in development work on extruded plastics. He was transferred to the Products Engineering Department in 1954, where he is now working.

Mr. Snyder attended Worcester Polytechnic Institute of Technology and was granted a degree of B.S. in Chem. Eng. in 1949. He worked for 9 months in the General Electric Laboratories and then joined Bakelite as a Development Engineer at the laboratories in Bound Brook. The Bakelite Company is a division of Union Carbide and Carbon Corp., New York, N. Y.

Since its introduction in this country thirteen years ago, polyethylene has been widely accepted as a wire insulating material. Today, millions of pounds of polyethylene are being consumed for insulating and jacketing applications. In addition to this, polyethylene has become a standard material for applications in film and sheeting, molding, and many other processes. But the commercial importance of polyethylene was first recognized during the war in wire and cable applications where it was employed as an outstanding flexible dielectric. For once a material was available which combined excellent dielectric properties, chemical, oil, moisture and oxidation resistance with low temperature flexibility, high tensile strength, and elongation. This excellent reputation has been based mainly on one class of polyethylene polymers which has been varied to a slight degree in crystallinity and molecular weight.

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Since such advances were made with one polymer type it was natural to investigate the possibilities of property variation through more extensive polymer changes. It was realized, however, that more rigid polymers would not supplant presently available polymers in the majority of applications, but rather would result in an overall expanded use of polyethylene in many industries. An example may be seen in wire and cable applications. Where thin-walled insulations of high strength are required, new polymers which have high rigidity will be of particular value. On the other hand, in large cable applications where a thick-walled jacket is required, the new polymers would have limited use due to this rigidity.

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During the past several years, extensive research and development work at Union Carbide and Carbon Corporation's Laboratories has served to illustrate the practicability of producing families of polyethylene polymers which differ substantially from one another. Obviously, a fuller range of property variations could be achieved through the production of such families. It is of interest to review briefly some of the important parameters affecting the properties of polyethylene, and to discuss in some detail a particular polymer of this family of polyethylenes which appears to offer substantial improvement in some properties desired by the wire and cable industry.

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Heretofore, some variations in molecular weight have been made with existing polymers. Considered by itself, variation in molecular weight has its greatest effect on low temperature properties and resistance to stress corrosion cracking. An increase in molecular weight normally improves both of these properties. Other properties such as stiffness and tensile strength are only slightly affected.

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The polyethylene polymer is both crystalline and amorphous in nature. The fact that the polymer combines these two components makes it particularly useful for wire and cable applications. A totally amorphous material would be soft and waxlike and would have limited use as an insulating material. A totally crystalline polymer would have brittle and glasslike characteristics and would also be of limited value. Not only are the two components of importance in polyethylene polymers, but also the ratio in which the components occur determines to some extent the final properties.

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It has been found in high pressure polymers that properties can be modified to some degree by varying the ratio of crystalline to amorphous constituents. Perhaps the best index of the degree of crystallinity in polyethylene is a density measurement. A typical high pressure process Bakelite polyethylene resin has a density of 0.92. This value corresponds to a crystalline content of about fifty-two per cent. An increase in crystallinity to approximately seventy-five per cent will give a density value of about 0.95. Such a material can be pro-

duced by a process which involves pressures considerably below those normally encountered in making polyethylene polymers. We will, therefore, refer to this material as a low pressure polymer and we will examine in some detail the specific differences between this polymer and a typical Bakelite high pressure polymer. This discussion will point out some of the reasons why a low pressure polymer appears to be particularly suitable for certain wire and cable applications. Table 1 gives a comparison of some important properties of these two polymers.

TABLE 1

	Low Pressure Polymer	High Pressure Polymer
Specific Gravity, 23/23°C.	0.95	0.92
Melt Index, 3/10 min.	0.4	1.5
Crystallinity, %	75	52
Brittleness Index, °C. 80%	-90	-70
50%	-95	-80

It will be seen that the low pressure polymer has a melt index of approximately 0.4 as compared to 1.5 for the high pressure process polymer. Melt index is a good measure of relative molecular weights of polymers having the same given crystalline content or specific gravity. However, when there are major differences in the crystalline content of the polymers, no definite conclusions can be made as to the relative molecular weight based on melt index measurements. In the case of the low pressure polymer, there is an increase in crystalline content and melt index would not give an accurate picture of the relative molecular weights of the two polymers. It is interesting to note that, despite the increase in crystalline content of the low pressure polymer (and, therefore, in hardness) the table shows an improved low temperature behavior.

TABLE II

Temperature, °C.	STIFFNESS IN TORSION, PSI Low Pressure Polymer	High Pressure Polymer
-50	310,000	230,000
0	175,000	48,000
23	100,000	24,000
70	25,000	7,000
90	14,000	too soft
100	9,000	

Table 2 summarizes stiffness in torsion measurements for both polymers. The low pressure polymer has approximately four times the stiffness of the high pressure polymer at room temperature. At low temperatures, the difference between these figures narrows although the low pressure polymer has still approximately fifty per cent more stiffness at minus 50 deg. C. At the other end of the scale, the high pressure polymer cannot be measured at 90 deg. C. due to distortion, while the low pressure polymer still has appreciable stiffness at 100 deg. C. (about 9000 psi).

TABLE 2A

YIELD STRENGTH*, PSI

Temperature, °C.	Low Pressure Polymer	High Pressure Polymer
23	3000	1400
60	2000	850
100	700	170
120	400	-

* At a rate of strain of one inch per minute.

Table 2A outlines the yield strengths of the two polymers over a temperature range from 23 to 120 deg. C. As with stiffness, the low pressure polymer has a higher degree of strength even at elevated temperatures.

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Figure I gives a graphic illustration of the improvement in high temperature deformation resistance which can be expected of low pressure polymers. Here, the high pressure polymer shows no deformation when the test is performed at 90 deg. C., but there is a sharp increase in deformation between 100 and 110 deg. C. The low pressure polymer gives a similar performance curve but at a level approximately 20 deg. C. higher.

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Figure II compares the temperature coefficient of expansion of the low and high pressure polymers. From these curves it can be predicted that the low pressure polymer would have a much lower coefficient of volumetric expansion over the useful operating range for wire and cable applications. This would mean that in applications where temperature cycling and subsequent expansion and contraction are encountered, the low pressure polymer would give far less difficulty than was previously thought possible with polyethylene.

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Briefly, we have seen that the low pressure process could be made to produce a polymer which deforms to a much lesser degree at equivalent temperatures, retains strength and stiffness at higher temperatures, and expands to a lesser degree than previously available polyethylene. These properties are significant in applications such as power cable where momentary overloads and concomitant high temperatures are likely to occur.

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Any discussion of the improvement of high temperature performance of polyethylene must include

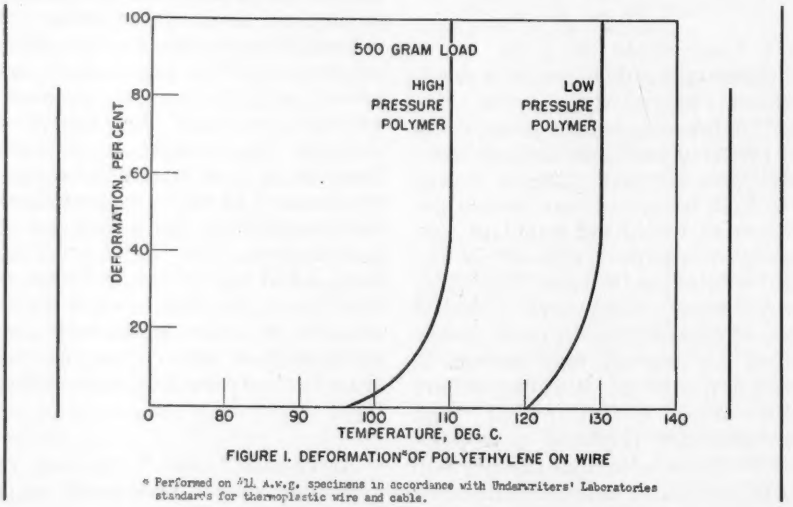

FIGURE I. DEFORMATION* OF POLYETHYLENE ON WIRE

* Performed on 40 A.W.G. specimens in accordance with Underwriters' Laboratories standards for thermoplastic wire and cable.

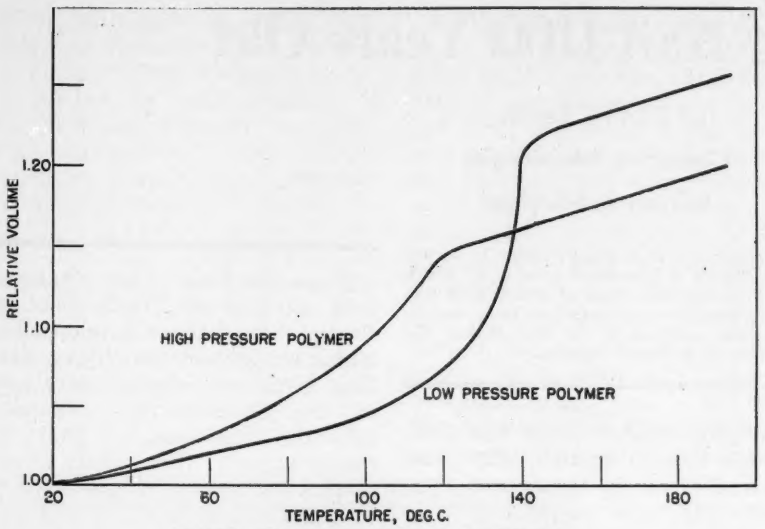

FIGURE 2. RELATIVE VOLUME VS. TEMPERATURE

a consideration of the ability of the polymer to resist oxidation. The low pressure polymer resists oxidation in about the same degree as other polyethylene polymers. With the low pressure polymer, oxidation resistance will still be a limiting factor on the high temperature, long-time performance.

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Electrical properties are another important consideration for wire and cable insulating applications. Table 3 compares the dielectric strength, dielectric constant, and power factor of low and high pressure polymers.

TABLE 3

Electrical Properties	Low Pressure Polymer	High Pressure Polymer
Power Factor, 50 mc.	0.0002	0.0002
Dielectric Constant, 50 mc.	2.25	2.25
Dielectric Strength av. V/mil for 0.125 in. step by step	530	500
short time	580	580

The values for the low pressure polymer are of the same order of magnitude as those previously reported for high pressure polymers.

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Since the low pressure polymer under discussion has been characterized by an increase in stiffness and toughness, some question may arise as to its performance in environments conducive to stress corrosion cracking. However a comparison of the stress corrosion cracking* performance of this material and high pressure polyethylene (Table 4) indicates that it is superior in this regard. A complete explanation for this improved performance is lacking, but it is presently believed to be the effect of true molecular weight and molecular weight distribution differences. The added resistance to deformation mentioned above may tend to minimize the propagation of surface defects which tend to promote stress corrosion. For this reason, resistance to stress corrosion would be good.

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The general mechanical properties of high and low pressure polyethylene are compared in Table 5. The low pressure polymer has a tensile strength approximately twice that of standard polyethylene. At jaw separation speeds of one inch per minute, the ultimate elongation, including cold drawing, is about equal to that possible with the high pressure polymer. The durometer hardness of the low pressure polymer is considerably higher. Comparative stress strain curves illustrated in Figure III in-

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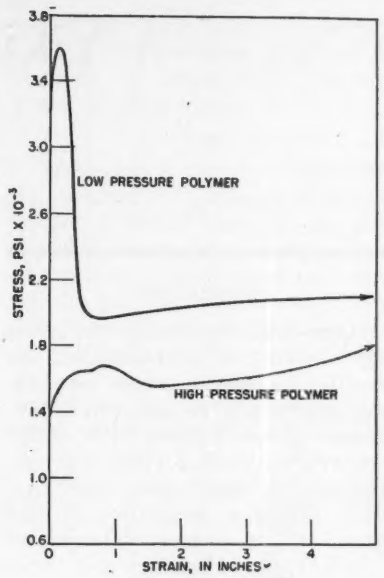

FIGURE 3. STRESS VS. STRAIN

TABLE 5

TYPICAL MECHANICAL PROPERTIES OF POLYETHYLENE POLYMERS

	Low Pressure Polymer	High Pressure Polymer
Tensile Strength, psi	3630	1700
Ultimate Elongation, % (including cold drawing,	600	600
Yield Strength, psi	3000	1400
Durometer Hardness @ 23° C. "D"	58	42

* Decost, Malm and Wallder, Cracking of stressed Polyethylene. INDUSTRIAL AND ENGINEERING CHEMISTRY, Volume 43 (Jan-Jun), 1951 p. 117 ff.

TABLE 4

STRESS CRACKING RESISTANCE#

	Low Pressure Polymer	High Pressure Polymer
Annealed by Boiling 30 min. in water	*F_o 48 hrs. **F_{50} 60	- <0.2
Aged 7 days at 70°C.	F_o 19 F_{50} 48	<0.2

DeCost, Malm and Wallder, Cracking of Stressed Polyethylene. INDUSTRIAL AND ENGINEERING CHEMISTRY, Volume 43 (Jan-Jun), 1951, p. 117 ff.

* F_o Time to initial failure

** F_{50} Time to 50% failure of 15 specimens at 50° C. in "Igepal" CA.

A Viking Nail 1100 Years Old

by Carl A. Zapffe,
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Baltimore, Maryland

Occasionally it is our privilege to secure articles of a historical nature, of which this is one. The saga of the Viking nail portrayed here is followed by a metallurgical analysis of it that makes the article of unusual interest.

Introduction

Many centuries before the making of iron and steel attained the status of a science, some remarkable products were achieved by artisans whose secrets still resist precise analysis in certain respects. The legends are legion which ascribe startling properties to the steels of Damascus, Khorassan, Golconda, and Toledo; and even where stripped of their mystery, relics of those times do show properties competing with some of the best materials produced today. The modern use of a particular metallurgical control in the manufacture of razor blades can probably be traced to the studies of Damascus steel at the close of the last Century.

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Recently an interesting opportunity has arisen for metallographic study of nails used in a famous Viking ship of the Ninth Century A. D. Although inferior to comparable modern products in both homogeneity and workmanship, these specimens have certain superior mechanical properties; and their remarkable span of history seems proof enough of their superior corrosion resistance. The story has both historical and technical interest.

The Vikings and Their Ships

For geographical reasons, the inhabitants of Scandinavia concerned themselves with boat-building from the earliest times. There are relics showing the usual Stone Age, Bronze Age, and early Iron Age progression in the Baltic area, the sea craft varying from primitive hollowed logs up to the masterpieces of the Viking Age. The Iron Age had reached Denmark from southeastern Europe and the Middle East about 200 B. C.; and from there it spread to southern Sweden about 150 B.C., middle Sweden another fifty years later, Norway in the Second Century A.D., and northern Scandinavia in the Third Century A.D. The very earliest plank-type craft were fastened by sewing, the seams being carefully caulked with various fabrics. The oldest known clinker-built specimen in Scandinavia is the Nydam boat found at Nydam in Slesvig, Denmark. Dated early Fourth Century A. D., its overlapping planks were fastened with iron nails. The craft is similar to the Sutton Hoo find at Suffolk, England. This latter ship has thrown new light on the early Anglo-Saxon history of England and the Pre-Viking visits to that country. This was a ship burial, a typically Swedish custom and one previously unknown in England. The wood had entirely disappeared, but the iron bolts and nails remained in place. Both the Nydam and Sutton Hoo boats were oar-type, the keel not yet having been developed.

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At Kvalsund in Heroya, Sunnmore, a Norwegian boat from about 600 A.D. was uncovered, and this showed the first use of a keel, also a rudder of later classic arrangement. These developments then laid the foundation for the use of mast and sail. Caesar in his Gallic conquest had encountered sailing vessels of the Veneti in the First Century B.C.; and the history of sailing, of course, reaches far deeper into history. Scandinavia's only claim to priority in this field lies in the design and the general quality of the craft which she finally developed.

From the time of the Kvalsund boat up into the Ninth Century there followed those developments which brought in the Viking Age. The fjord and coastal operations of the Scandinavians expanded into the open sea, so that in Charlemagne's time there were serious contests with the Vikings on the coast of Normandy. About the middle of the Ninth Century, Norsemen were in Iceland. In 874 A.D., a band of Norwegians, fretting under the dictatorship of Harald Haarfager, migrated to Iceland; and shortly thereafter a Norwegian skipper named Gunnbjorn Ulfsson sighted Greenland. A century later Thorwald and his son Eric the Red established a Norwegian colony in Greenland. In 986 A.D., Bjerne Herjulfsson discovered Labrador; and in the year 1000 A.D., Leifr Eiriksson discovered "Vinland", which was some unidentified portion of the North American Continent between Newfoundland and Cape Cod. Leif (or Leifr) and his crew spent the winter in this new land, having some sort of contact with the Indians; and in 1002 A.D. his brother Thorwald spent the winter there with thirty men. Durant in his monumental **The Story of Civilization** reports five different expeditions of Norsemen to continental America between 985 and 1011 A.D. Iceland by 934 A.D. was as thickly populated by these immigrants as it was found to be during World War II; but the Viking operations farther west bore no permanent fruit, unlike the voyages of Columbus half a millennium later.

The Oseberg Skibet

Among a number of historical specimens of boats and ships which have been uncovered in Scandinavia, there have been three great

Viking ship finds: The Tune, Gokstad, and Oseberg. These are now on display in the Viking Ship Hall at Bigdoy. An exact duplicate of the Gokstad, renamed the "Viking", sailed under Captain Magnus Andersen from Marstein, Norway, to Newfoundland April 30-May 27, 1893, as a feature of the Columbian Exposition being held in Chicago that year. The ship is on exhibit now in Lincoln Park, Chicago. The demonstration was a rather convincing one that America had discoverers other than Columbus.

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Of the three great Viking specimens, the Oseberg is the showpiece. Built about 800 A.D., it was used as a burial cairn for a Queen and her bondwoman in the latter part of that century. The mound was about 130 feet across, and lay near Oseberg-Odegarden in the parish of Slagen, Norway. It was discovered in 1903, and excavated in 1904 as shown in Figure 1. The ship lay with its prow southward toward the sea, made fast by a hawser to a large rock; and 15 horses, 4 dogs, and 1 ox were found co-interred. The entire assemblage was covered with rocks, then peat, this latter forming a remarkable hermetic seal and affording a consequent excellent state of preservation.

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In Figure 2, the vessel is shown as restored in 1936 and displayed in the Oseberg Room of the Historical Museum in Oslo. Many thousands of wood fragments comprising the ship and its cargo were meticulously boiled in alum and then dried and impregnated with linseed oil by Gustafson and Johannesen, one sledge alone having 1068 pieces (see **The Viking Ship Finds** published by the Museum in

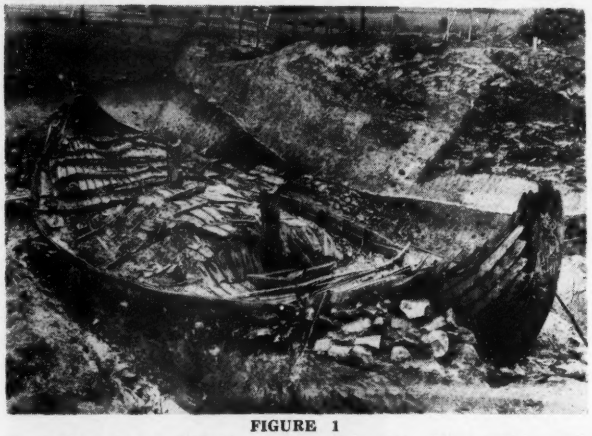

FIGURE 1

The Oseberg ship or SKIBET as excavated in 1904. The original mound was about 130 feet in diameter and 20 feet high, standing on a plain close to a small river and several miles from the sea, at Oseberg-Odegarden in the parish of Slagen, Norway. It was moored to a large stone by means of a hawser, with its bow pointing south towards the sea. A queen lay in the burial chamber behind the mast. * * * *

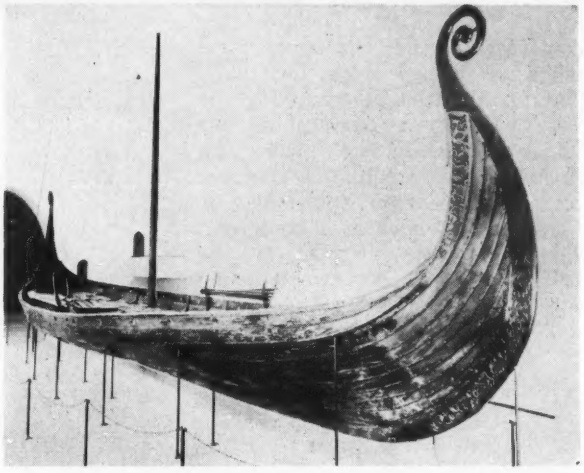

FIGURE 2

The restored OSEBERG SKIBET on display in the Oslo Museum. * *

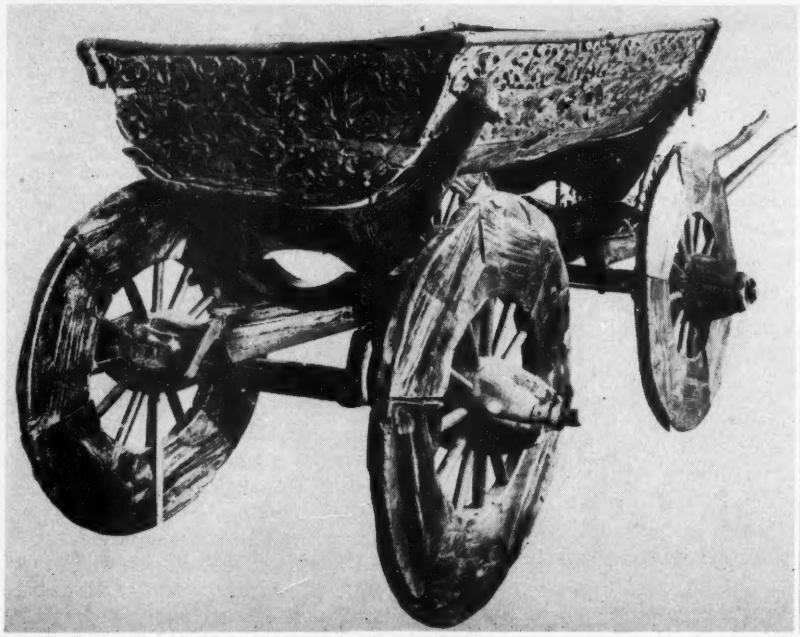

FIGURE 3

Elaborately carved vehicle from the Oseberg burial. * * * * * * * * * *

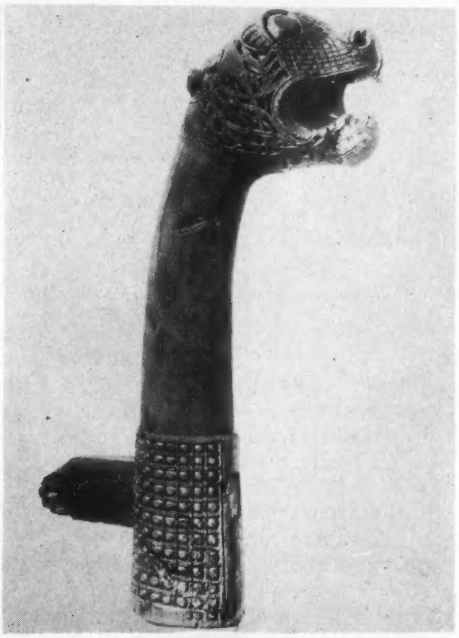

FIGURE 4

An example of a carved post head from the Oseberg burial. * * * * * * * * * *

1952). The length of the ship is 71 feet 6 inches over-all with a 17-foot beam. From the bottom of the keel to the gunnel is 33-½ inches amidships, but the prow and stern rise to a height exceeding 16 feet. The draft is about 30 inches. There are positions for fifteen pairs of oars and fittings for a mast. The boat is clinker-built, the nails scarcely being rusted; the planking is caulked with 3-ply yarn spun from animal hair. Among the burial materials there were found iron cauldrons and stands, axes, ladles, knives, beds, chairs, a loom, oak chests decorated with tinned nails, an elaborate four-wheel cart, and so forth. Figure 3 shows this cart. Each of the large beech-wood wheels is lashed to its own axle. The front wheels are united to the rear pair by a long center bar which forks at the back. The forked ends are bolted to the rear axle while the front wheels can be turned independently of the rear. The ash shafts mounted on the fore-axle and the two wooden pieces which join the shafts to the axle are richly carved with figures of animals. Figure 4 shows the carving of one of the posts. Figure 5 shows the chest with its rather remarkable metal work.

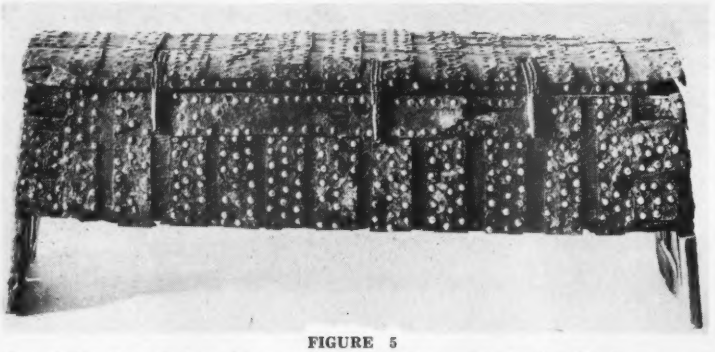

FIGURE 5
One of three large Oseberg chests, made of oak and decorated with tinned nails. * *

A Viking Nail

One of the nails from this Oseberg craft was given to the present writer by B. Egeberg of the International Silver Company, through L. F. Weitzenkorn of the Armco Steel Corporation; and a Swedish nail from the same Viking Period was submitted by T. Althin, Director of the Tekniska Museet in Stockholm. An etched longitudinal section of the Oseberg nail is shown in Figure 6. An analysis of this nail and a duplicate from the same ship was reported as follows:

Element	Weight Per Cent Nail 1	Nail 2
C	.22	.22
Si	.02	.02
Mn	.04	.03
S	.005	.006
P	.075	.116
N	.003	...
Alloy Elements	None	None

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The nail in Figure 6 is 1.98 inches long. Unfortunately, it is not known which of the two analyses applies to this particular specimen, but they are virtually identical except for phosphorus content.

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On this etched section, the pronounced banding leaves a clear record of the forging operations, and the microstructures enable one to reconstruct the thermal history of the nail-forming operation. The banding is caused by the two extremes of heavily carburized metal on the one hand, and ferrite with oxidic inclusions on the other.

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In the following Figure 7 the microstructure of the carbidic seam is shown in the upper micrograph. It is seen that an analysis of 0.22%C for this steel is highly misleading, since it is nothing but an average over a heterogeneous microstructure which varies from practically carbon-free ferrite to the nearly eutectoidal composition in the micrograph. This is a Widmannstatten structure, with an important proportion of the ferrite forming in the austenite grain boundaries and the remainder occurring along the octahedral {111} planes which become the dodecahedral {110} of the ferrite. The structure shows a carbon content which certainly exceeds 0.60%, and in places approaches the eutectoidal 0.83%. This is an interesting observation for it shows a utilization, whether by chance or otherwise, of one of the great principles of Damascening for increasing the mechanical properties of a simple ship nail. The heavily carburized seam, of course, contributes great strength and stiffness, whereas the surrounding ferrite not only supplies ductility, but also increased corrosion resistance

FIGURE 6
Longitudinal section of a nail from the OSEBERG SKIBET. Approximately 2 inches long, the nail has been sectioned longitudinally through its approximate center, then polished, and etched with nital. The dark continuous band on the right is a carbidic seam, the shorter central bands to the left being oxidic inclusions. The flow structure accurately records the forging and heading operations; the heterogeneity of the constitution reveals the variably oxidizing and carburizing conditions of the ancient bloomery operations; and the grain structure, particularly as shown in the following micrographs, permits an analysis of the temperature range in which the metal was worked, also the approximate rate at which the finished nails were cooled. 8 X

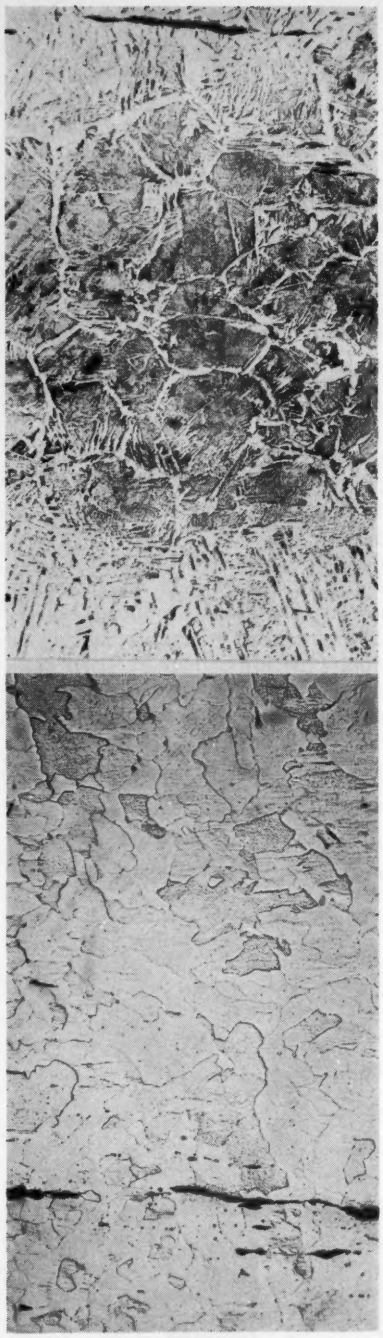

FIGURE 7

Typical microstructures of carbidic and oxidic areas. (Top) The carbidic band shows a Widmannstätten structure typical of moderately slow cooling, with proportions of ferrite and carbide which show the composition to lie within the 2-phase region, and close to the eutectoid. (Bottom) The ferritic areas are devoid of visible carbide, showing instead excesses of oxide in the form of inclusions. 125 X

where surface layers are ferritic.

★ ★ ★

Finally, two micrographs in Figure 8 show slag stringers in a ferrite matrix, carbide being completely absent. These are principally iron oxide, though the ones on the right have a duplex structure suggesting Fe-Mn sulfide or phosphide.

Remarks on Ancient Nail-making

On the basis of these observations, the operations of the Viking smith can be closely reconstructed. First, the macrostructure is typically that which is produced by direct reduction of iron ore in a bloomery furnace. There the layer-like charge of charcoal and iron ore, the latter mixed with unslaked lime, is reduced to a ferrous sponge, which is then consolidated by hammering, next cut into usable pieces by hammerblow against a sharp instrument. The pieces are reheated and then shaped into bars or, in this case, nailer's rod. This rod would be pointed, cut to length, dropped in a die or "nail tool", hot-upset, then dropped upon the floor to cool. Rhodin has described one of the last historic Swedish nailers in which the nail forge was operated by a "whip hammer" driven by a water wheel. The master smith, two strikers, and one boy were forging ¾-inch nails from 1½-inch bar stock, producing them at a rate of approximately a dozen per minute.

★ ★ ★

Very likely, this process did not differ much from that of Viking times. Nails were all handmade until about 1750, the smith being called a "nayler", which has survived in the surname of Naylor today. Old English of five hundred years ago refers to a "nayle tulle" or nail tool, being the steel form or die upon which the head was formed by hammering or hot-upsetting. Various sizes from tacks to spikes were produced, the tacks sometimes being tinned, as mentioned during the description of the Oseberg ship. Thus one can find old discussions of strake nails, "tyngyl nailles", spykynges, golettes, haxnailles, sharplinges, fly wings or sparabilis ("sparrow bills"), travers nailles, and so forth. Blacksmith tools used in Viking times are on display in the Tekniska Museet in Stockholm; and anyone interested in these matters will be greatly rewarded by visiting Williamsburg, Virginia, where an "Eighteenth Century smith" will be found in the restored part of the city actually making nails and other tourist pieces by precisely the process under description here.

★ ★ ★

To return to the metallographic analysis, some of the furnace operations have left their record in the carbide streak and the adjoining carbon-free surface. Either this carbide derives from an entrapment of charcoal in the bloom, or else it is the remnant of severe surface carburization during reheating of the forged piece at a very high temperature. In that case, the surfacial ferrite represents decarburization during the subsequent working.

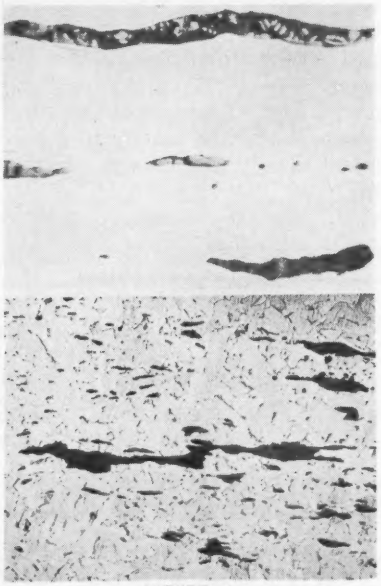

FIGURE 8

Typical inclusions from central portions of the nail. At the left the inclusions seem to be principally iron oxide, differentiated only by some very fine secondary structures; whereas the inclusions on the right clearly show a secondary phase. 125 X

Information of a more precise nature can also be obtained from the micrographs. The structure of the inclusions in Figure 7 and 8 shows that the metal has been worked at temperatures clearly exceeding 1700° F (~925° C), since the lowest temperatures that can possibly be assigned to the liquidus of any of the inclusions in this type of iron would be the eutectic at 1670° F (910° C) in the Fe-Mn-S-O system. Iron oxide itself has

(*Please turn to page* 1523)

Government Wire Production Information

Nickel Production In Cuba Increased

Nicaro, the giant Government-owned nickel plant in Cuba, has opened its fourth year of full operation with new achievements in nickel production to its credit.

★ ★ ★

In announcing Nicaro's top-flight performance, **Edmund F. Mansure,** Administrator of General Services, pointed out that they were achieved under the handicap of an expansion program which will increase the plant's capacity by 75 percent.

★ ★ ★

"These highlights," Mr. Mansure said, "factually refute the nonsense about slipshod operations at Nicaro. They sum up the achievements and testify to a record of steady progress in production."

★ ★ ★

The records cited by Mr. Mansure are:

1. **Nicaro produced at the annual rate of 31,215,000 pounds of nickel in the last three months. As an all-time high, never before achieved, the rate tops the target of 31,000 000 pounds set when the plant, built in World War II, was returned to operation after a post-war shutdown.**
2. **Nicaro has produced nearly 100,000,000 pounds of nickel since it was started up in January 1952. It went into full operation six months later.**

★ ★ ★

These results are promising for the future of Nicaro when the expansion has been completed. With accomplishments of this character to its credit, Nicaro can advance steadily toward a highly successful commercial enterprise. This is GSA's goal. The present records point the way to leasing or selling the plant without sacrificing the Government investment after the expansion has proven itself.

The nickel facility, located 450 miles east of Havana in Oriente Province, is the largest installation in the National Industrial Reserve, a pool of defense plants maintained by the GSA Public Buildings Service, Nicaro's operation and expansion are supervised by the GSA Nickel Committee which is headed by **James P. Pinkley,** Director of NIR.

★ ★ ★

Nicaro's new production record rests upon the output for July, August and September—the first quarter of the plant's fourth year of full operation. In these three months, the plant produced 7,803,724 pounds of nickel, including a minor fraction of cobalt. The quarterly total is equivalent to an annual output of 31,215,000 pounds.

★ ★ ★

Based upon current nickel prices, the total output represents a dol-

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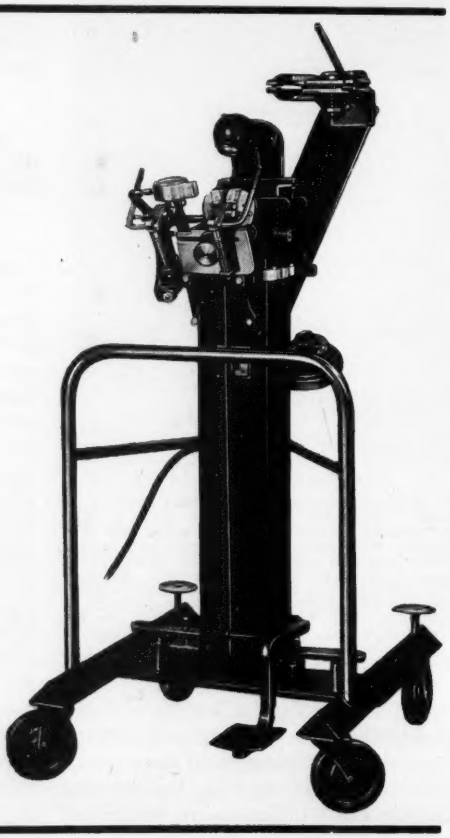
These welders are used for welding high and low carbon STEEL, and STEEL ALLOY wire, ranging in size from .020" to .160" diameter. All operations on these units, which include the clamping of the wire being welded, contacting the welding switch, and upsetting the weld, are made by a single downward stroke of the foot pedal. Welders for high carbon steel wire are equipped with the exclusive MICRO-WELD Dial indicating annealing device to facilitate the annealing operation of high carbon wire.

Standard equipment with these units include annealing dies, filing vise, light extension cord, and mounting on a 4-wheel truck. Special units can be furnished for crane mounting.



MICRO PRODUCTS CO.

20 NO. WACKER DR., CHICAGO 6, ILL.
Telephone: STATE 2-7468

lar value approaching $60,000,000. At present, nickel prices range from 59¾¢ a pound for nickel oxide powder to 64½¢ a pound for nickel metal. The Nicaro production is divided between the United States stockpile and the open market where it is sold mainly to the steel industry. The stockpile has paid for its receipts at GSA's cost of production which has been consistently less than the market price.

★ ★ ★

The Nicaro operation has had the support and cooperation of the Cuban Government. Moreover, Nickel Processing Corporation, the operating company, is owned jointly by National Lead and a Cuban firm, Fomento de Minerales Cubanos, S. A.

★ ★ ★

Held in standby condition after March, 1947, the plant was reopened at the request of the Munitions Board. The rehabilitation got underway in January, 1951, and operations were resumed a year later.

ASTM Actions of Interest to Wire Men

Statistical sampling procedures for tin-coated soft copper wire (B 33) and for lead-coated and lead-alloy-coated soft copper wire (B 189) will very likely come from **Committee B-1 on Wires for Electrical Conductors** in 1956. Much of the necessary test data has been compiled, but additional data on the larger sizes of wire are still being collected.

★ ★ ★

A large amount of data using the low stress elongation (LSE) test for stiffness of bare magnet wire has been collected. These will be analyzed with a view toward establishing limiting values for specification requirements.

★ ★ ★

The Signal Corps Engineering Laboratories at Fort Monmouth, N. J., last year contacted the committee regarding the possibilities of tin transformation when tin-coated copper wires were exposed to arctic temperatures. A task

Due to the unusual deep socket in the above Adjusting Screw it could not be formed from regular annealed and processed cold heading wire.

Keystone's metallurgist recommended Keystone "Special Processed" wire. The manufacturer has now standardized on "Special Processed" wire for this and other difficult cold headed parts. His results have been improved quality, increased production and lower cost per unit.

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• *CABLE LACQUERING SYSTEMS*

Conventional cellulosic, or other type, lacquers are applied in successive continuous coats from one to twenty-eight coats over fibrous braid wrapped primary conductors. One end, four ends, or eight ends of wire are handled continuously. System includes letoff, application, drying and constant tension takeup equipment.

• *WIRE ENAMELING SYSTEMS*

Natural and synthetic enamels, silicones, solution nylon, modified plastisol, and similar insulating coatings are applied to bare, cotton or glass covered wire in round, square or rectangular cross section. Ten or twenty simultaneous strands are handled. Systems are complete with letoff, preannealer, application system, capstan and multiple takeup unit.

• *ASBESTOS INSULATING SYSTEMS*

Carded asbestos is applied to continuous single conductor as an integrated operation with saturating, rotary forming, drying, cooling and polishing of the finished wire. Wire from No. 20 gauge to No. 6 AWG is handled through an asbestos wall thickness range of from .008" to .040" thickness in a single pass.

• *RUBBER OR PLASTIC JACKETING SYSTEMS*

Rubber and thermoplastic jacketing compounds are continuously applied to electrical wire or cable by the extrusion method. High speed, constant tension letoff and takeup equipment, controlled cooling or continuous vulcanizing equipment are powered by synchronized range drives as complete, integrated wire handling systems. Extrusion machines of customer's choice are furnished.

• *GLASS & VARNISH COATING SYSTEMS*

Double layer of glass or cotton wrapping is applied to round, flat or square conductor. Two individual coatings of high temperature varnish are applied and the finish baked in a continuous operation. Units are complete from letoffs to takeup frames.

• *SELF TRAVERSING REEL CORD DRYERS*

These ingenious machines are used to remove hygroscopic moisture from fibers, braided or knitted flexible cable. These machines increase extrusion speeds, reduce blister scrap loss and improve diameter control. They are easily installed in existing extrusion line.

TECHNICAL INFORMATION ON ANY OF THESE PROCESSES UPON REQUEST

C. A. LITZLER CO., INC.

11621 DETROIT AVENUE

CLEVELAND 2, OHIO

group was organized to work with the Signal Corps and a program for longtime cooperative tests has been arranged.

★ ★ ★

Committee B-4 on Metalic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts is continuing work on the revision of Method B 70 for determining change of resistance with temperature. The report of one more laboratory is needed before the revision will be proposed. This will necessitate changes in Specifications B 82 and B 83 covering wrought alloys for electrical heating elements.

★ ★ ★

Three formal reports have been presented suggesting specific procedures for including a life test for the iron-chromium-aluminum type alloys in Method B 76.

★ ★ ★

The committee is still attempting to formulate a clear definition of "green rot" attack and to obtain specific examples of the phenomenon. Many failures classified as "green rot" are actually unrelated.

New Census Report Nearing Completion

The 1954 Census of Business and Manufactures is nearing completion and is expected to be ready for distribution beginning in November and continuing to the end of the year. Final reports will be ready early in 1956.

★ ★ ★

Copies of such portions as may interest persons may be secured from the Public Information Office, Bureau of the Census, Washington 25, D. C.

Wire Woven in Cloth Answers Many Industrial Needs

Wire cloth covers the whole vast range of industry—aviation, automotive, appliance, mining and construction equipment, to name a few—and its products are many and varied. They range from seed crop graders to spark arrestors, carburetor air screening for planes to the familiar tea strainer basket

in the kitchen. The cloth has such diverse uses as filter for ships' piping systems, as earth-retaining wall, and as the basic element in reinforced concrete slab construction. In everyday living, there's scarcely any one who doesn't come into contact with at least one of these wire-woven products.

★ ★ ★

Leading producer of wire cloth is **The Reynolds Wire Division of The National-Standard Company,** Dixon, Illinois. Pioneers in the industry since 1894, Reynolds makes wire cloth in a diversity of weaves and patterns to meet regular and special industrial and commercial requirements.

★ ★ ★

In some instances, gauges are so fine that they are measured in ten-thousand parts of an inch. To make wire cloth, the rod is drawn into wire to the desired size. The wire is then placed on bobbins which supply warp and filler wire to specially-built looms which convert the wire into cloth. Special machines split the cloth for particular applications.

★ ★ ★

This cloth, for example, is used to insulate delicate instrumentation from stray currents, combining excellent conductivity for shielding with strength for permanent installation. It can be used as fanning mill cloth, because of its dimensional stability and precise grading. Another unusual application is as a carrier of "wet lap," which comprises the woody fluid compound used to form hardboard for walls.

★ ★ ★

Wire cloth plays so many roles in modern industrial progress that the average person takes the miracle fabric for granted.

★ ★ ★

In the auto industry it is used in oil filters, fuel strainers, air cleaners and radio grilles. As auto brake lining, it provides more effective braking and longer life.

★ ★ ★

In aviation, it is used as carburetor air screening, firewall fuel

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Titan Brass Wire has precisely uniform gauge . . . color . . . texture . . . temper . . . is free from physical defects. For making highest-quality rivets, bolts, nuts, eyelets, fasteners, screws, studs, binding posts, terminals, washers, pins and nails . . . order Titan Brass Wire. Compositions and tempers are supplied to meet every requirement. Let us help you choose the proper wire composition and temper for **Heading & Extruding**
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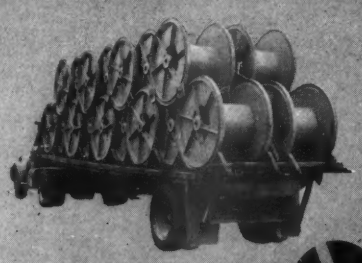

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★ ★ ★

On the farm, the tractor, the combine that reaps and thrashes the farmer's grain, the water pump, even the cream separator—all contain wire cloth as a basic element. In the tractor itself, the grilles, screens, strainers, spark-arrestors are wire-clothed.

★ ★ ★

At home, the vacuum cleaner, the flour sifter, the refrigerator, the kitchen range, and numerous other appliances are wire-clothed.

★ ★ ★

The diesel locomotive uses wire cloth to keep foreign matter out of the engines.

★ ★ ★

Wire cloth is used to protect exposed machinery from careless hands from the machinery. It plays an important role in converting wood pulp and other vegetable fibers into paper. In metal-making, baskets with wire cloth are essential in manufacturing operations. It is also used in the clay and ceramics industries.

★ ★ ★

As shaker screen, it grades rock, ore, abrasives, powder and coal. In some cases, it can be used as a substitute for glass. Often, it adds decoration to its utilitarian role.

★ ★ ★

Wire cloth is shuttle woven in plain, twilled or locked weaves on specially-built wire looms. It is normally woven in widths from 24 to 48 inches and furnished in rolls containing 100 lineal feet. The cloth is woven in many metals. Those most frequently used include:—plain, coated and stainless steel, brass, bronze, aluminum, phosphor bronze, copper, monel and nickel. Protective coatings are applied to all types of wire cloth.

★ ★ ★

When Reynolds began the manufacture of wire cloth more than 50 years ago, it was used primarily for insect screening. Today it serves all industry with many and varied applications.

ABSTRACTS

WIRE DRAWING ON THE CAUSES OF CUPPY DEFECTS IN A DRAWN MATERIAL [WIRE]

H. Tanaka. Nippon Kinzoku Gakkai-Shi 1952 Vol 16 (10) pp 567-571 Inst Met Journ: Metall Abstr 1955 Vol 22 (12) col 1217 (Aug) (Original in English)

Causes of fracture in drawn Al- and Cu-base materials investigated and 2 types distinguished: irregular fractures due to defects in metal and typical 'cupping' fractures, due to slips from shear, arising out of unsuitable drawing conditions. Instances found in which irregular fractures developed from both causes combined.

★ ★ ★

WIRE MACHINERY ON SHOW AT HANNOVER: DIAMOND AND SINTERED CARBIDE DIES

Anon. Wire Ind 1955 Vol 22 (260) pp 798, 801-802 (Aug)

Preview of Hanover Trade Fair, Sep 1955. Complete range of diamond tools to be shown by J. Urbanek & Co: drawing dies with holes from 0.063 mm set in hard solder and steel mounts; dies from 0.1 mm downwards in super steel mounts, allowing increase of fine and medium dia to multiple of initial dia, and guaranteeing economy in use. Sintered carbide dies and draw matrices with hole dia from 0.05 to 80 mm. Adjustable matrices in various shapes. Diamond die polishing machine TNP 53 and universal sintered carbide die polishing machines HPUK. 6 illustr.

★ ★ ★

MULTIPLE WIRE DRAWING MACHINE DZ 2. MEHRFACHDRAHTZIEHMASCHINE DZ 2

BEMA Maschinen- & Apparatebau. Draht 1955 Vol 6 (7) p 284 (July) (In German)

Description of wire drawing machine for dia from 2 to 0.4 mm, using up to 17 dies. 1 illustr.

★ ★ ★

INSTRUMENTS [DIES] FOR DRAWING WIRE, RODS, TUBES, ETC

N. Z. Dnestrovsky. DSIR Transl Cont Lists Russ Period 1955 (77) p 103 (Aug) (Original in Russian)

Book, Gozenergoizdat, Moscow, Leningrad, 1954, 482 pp. Available in Brit Mus Library.

★ ★ ★

THE WEAR OF DIAMOND DRAWING DIES. DER VERSCHLEISS VON DIAMANTZIEHSTEINEN

P. Grodzinski. Stahl & Eisen 1955 Vol 75 (17) pp 1111-1112 (Aug) (In German)

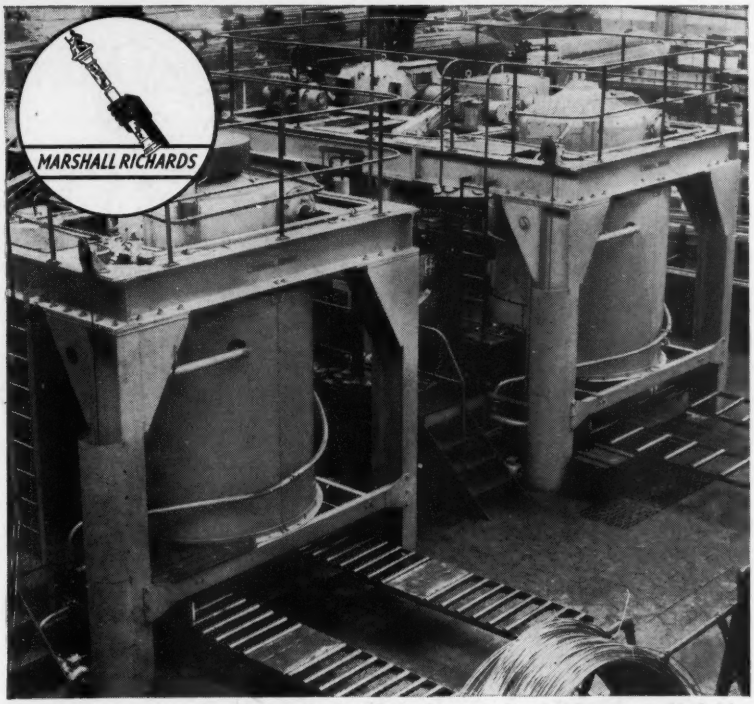
Abstr of investigations by L. Schultink, H. L. Spier, A. J. van der Wagt. See Bibl Ind Diamond Appl 1955 Vol 12 p B136 (May).

★ ★ ★

FROM WIRE DRAWER TO NEEDLE HARDENER. VOM DRAHTZIEHER ZUM NADELHAERTER

Klein. Draht-Welt 1955 Vol 41 (13) pp 181-182 (July 10) (In German)

Short review of index of professions (Verzeichnis der Berufe) issued by Bundesministerium fuer Arbeit, Bonn. Index contains names of 80,000 different



Marshall-Richards vertical inverted tube blocks in operation for 2 years at Yorkshire Copper Works Ltd., Leeds, England. Typical drawing cycle, from 1.875″ o.d. and .094″ wall thickness to .322″ o.d. and .028″ wall thickness, in 8 passes. Drawing speeds from 225 to 2,025 fpm available.

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Just as a tailor skillfully measures and shapes a suit to fit each meticulous customer, Apco Mossberg engineers design and construct steel reels, spools and bobbins for the wire industry.

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professions, of which about 200 are connected with wire industry.

★ ★ ★

MULTIPLE WIRE DRAWING MACHINE TYPE 354. MEHRFACH-DRAHTZIEHMASCHINE TYPE 354
Maschinenfabrik Niehoff KG. Draht 1955 Vol 6 (7) p 285 (July) (In German)
Wire drawing machine with 17 dies for 21 to 24% elongation. Drawing of copper wires from 3.5 mm to 0.18 mm. Machine also obtainable for 25 dies. 1 illustr.

★ ★ ★

REVERSIBLE DIAMOND DIE
Nat Wire Die Co, NY. Ind Diamond Rev 1955 Vol 15 (178) p 175 (Sep)
New American development for better utilization of diamond dies. Increase of life in some cases over 100%. If die life of 10,000 lb wire expected, recommended to reverse die after drawing 7,000 lb and continue drawing for another 7,000 lb, thus increasing total production by 4,000 lb.

★ ★ ★

ELECTROSPARK TREATMENT OF WIRE-DRAWING DIES MADE OF SINTERED CARBIDES
Z. Steininger. Hutnik 1955 Vol 22 (3) pp 87-89 (Mar); Battelle Techn Rev—Abstr 1955 Vol 4 (8) p 489a (Aug) No 10656 (Original in Polish)
Design of electrospark machining equipment. Use and operation of device and its advantages over mechanical polishing methods.

★ ★ ★

WIRE DRAWING MACHINE WITH DIFFERENTIAL BACK-PULL. DRAHTZIEHMASCHINE MIT DIFFERENTIAL-GEGENZUG
Anon. Draht 1955 Vol 6 (7) pp 276-277 (July) (In German)
Description of machine which has 2 drums, one above other, for wet and dry drawing. Drawing speeds up to 9 m/sec obtainable. 3 illustr.

★ ★ ★

75th ANNIVERSARY OF THE ELECTRIC LAMP
Anon. Ind Diamond Rev 1955 Vol 15 (178) p 170 (Sep)
Short note drawing attention to development of electric lamp which led, after 1911, to use of ductile tungsten filaments drawn through diamond dies.

These abstracts are published through the courtesy and with the permission of the Industrial Diamond Research Bureau, 34 Holborn Viaduct, London, E.C.1, England. Inquiries regarding them should be directed to the Bureau.

Heads Metallurgy for Bristol Brass

Orvin A. Klema has been appointed Chief Metallurgist of **The Bristol Brass Corp.**, Bristol, Conn. He succeeds Horace W. Staples, who recently retired. He had been Production Manager.

Outstanding Personalities of the Wire Industry

National-Standard Sales Shifts

The National-Standard Company of Niles, Michigan, leading manufacturer of wire products, has named **Joseph A. Hand** as District Representative for the State of Michigan. Mr. Hand, with National-Standard 23 years, will make his headquarters in Detroit.

* * *

Jack J. Gruber replaces Mr. Hand as District Representative of Ohio, and will make his headquarters in Cleveland. Besides Ohio, Mr. Gruber's territory includes Kentucky and western Pennsylvania.

* * *

Mr. Hand, 41, the Company's District Representative in Ohio the last 17 years, joined National-Standard when he was 19.

* * *

Mr. Gruber, 43, joined National-Standard in July 1944. Before that, he had been a manufacturers' representative. He attended the Carnegie Institute of Technology.

Resistoflex Expands Sales Staff

William Spangler has been appointed head of a newly established Kansas City sales office and **M. H. Eberle** has been appointed sales engineer at the Chicago office of the **Resistoflex Corporation,** Belleville, N. J., manufacturer of specially engineered flexible hose assemblies and plastic materials for the aircraft and other industries.

L.O.F Glass Fibers Appointments

J. M. Johns, Vice President and Director of Sales, **L.O.F Glass Fibers Co.,** Toledo, Ohio has announced the following appointments:

* * *

Thomas D. Leathers has been named District Manager of the Pittsburgh Area. He will have offices at 3829 Willow Avenue, Pittsburgh 34, Pa.

* * *

G. O. Hartzell has been appointed District Manager of the Toledo Area, with offices at 2100 Madison Avenue.

* * *

James J. Secor, Jr. was named District Sales Manager of the Philadelphia area, and will headquarter at the company's branch office at Narberth, Pa.

* * *

George R. Frick is now field representative in the Boston area, with headquarters at 701 Washington Street, Newtonville 60, Mass.

* * *

Francis W. McPeek is District Sales Manager of the Cincinnati area.

* * *

Edward A. McCabe has been

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a NAME and MACHINE
that have stood for
DEPENDABILITY since 1887

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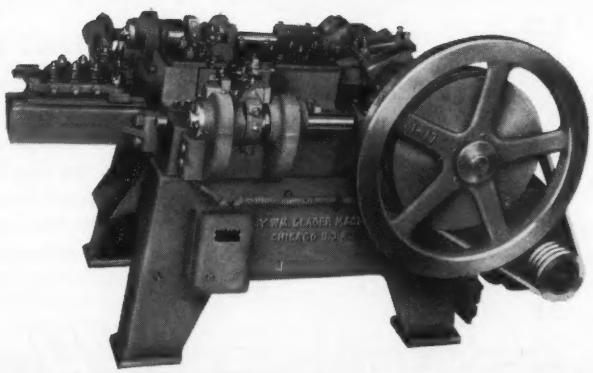
"KNOW-HOW"
means $$$ for you



Wm. GLADER MACHINE WORKS 210 N. RACINE AVENUE CHICAGO 7, ILLINOIS

EXPORT DEPT. 122 EAST 42ND STREET • NEW YORK 17, N. Y.

made District Sales Manager of the New York area.

★ ★ ★

William R. Browne has become field representative in the New York area. He will work with Mr. McCabe at 441 Lexington Avenue.

Walker Wire & Steel Expands

Walker Wire & Steel Company Ferndale, Mich., has added an 8,000 square-foot storage building to its facilities, it is announced by **Clifford L. Jackson,** president. He also revealed the promotion of **James H. Allen** as vice president—sales for the company.

Appointed to Tool Steel Post by Universal-Cyclops

Norman W. Calkins has been appointed assistant manager of tool steel sales and assistant to Vice President **W. J. Long** by **Universal-Cyclops Steel Corp.,** Bridgeville and Titusville, Pa. He will make his headquarters at the Cyclops Division in Titusville.

★ ★ ★

Mr. Calkins had been a member of **The Carpenter Steel Company** sales organization for the past nine years, four years of which was in the Carpenter export division, traveling extensively through South America and Europe. Previous experience covered tooling and tool heat treating.

Goss Made President of Scovill

Directors of the **Scovill Manufacturing Company** have formally announced the election of **William M. Goss** as president of the corporation to succeed **Leavenworth P. Sperry,** who has been elected board chairman.

★ ★ ★

Mr. Sperry has been identified with Scovill's for more than 50 years. His late father, Mark L. Sperry, who served as president of the company from 1918 to 1920, had been associated with the company for 64 years.

★ ★ ★

The new president has been associated with Scovill's since 1944, previously as secretary and as a vice president. His late father, **Edward O. Goss** was president of the company from 1920 to 1938.

★ ★ ★

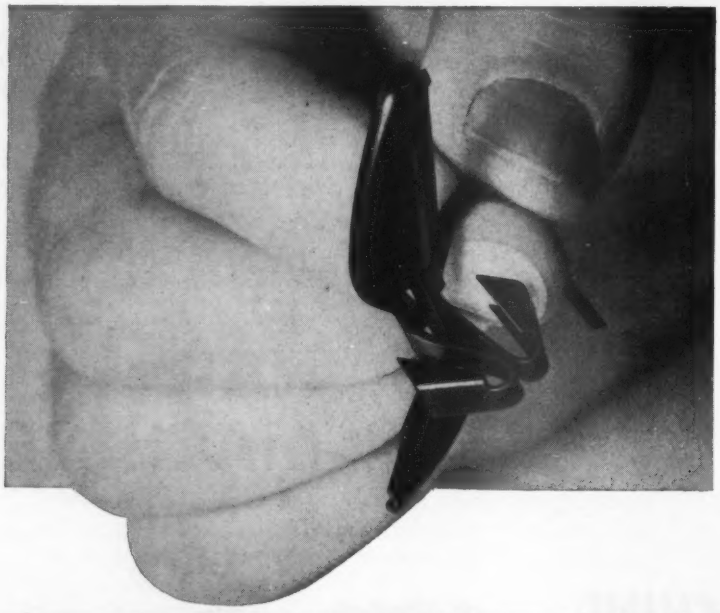
The directors also announced that **Mark L. Sperry 2nd,** son of Leavenworth P. Sperry, has been appointed executive vice president and general manager. He joined the company in 1938, served as secretary from 1946 to 1952, when he assumed the duties of treasurer.

★ ★ ★

The creation of a Board of Administration, which will be the liaison between the directors and managers of the company's various divisions has been announced. The board will determine basic policies for operations and will review operations. It will include the president, executive vice president and **Ivan M. Coulter, Arthur M. Rogers, George W. Young** and **Norman H. Schlink,** all of whom have been appointed administrative vice presidents.

Elected Vice President of Anaconda's Aluminum Unit

C. Jay Parkinson was elected vice president of **Anaconda Aluminum Company** by the board of directors at the meeting on September 27th. He was also elected a



THIS ONE WAS EASY . . .
A Nilson 4-Slide, Number 1, forms 150 drapery hooks per minute from 0.70 basic steel wire. Nilson 4-Slides form wire or ribbon stock from the coil. They straighten, feed, pierce, blank, swage, stamp or coin, cut and form in one, fast, automatic operation . . . accommodate wire up to .5" dia., in feeds to 32" max., and ribbon up to 3.5" wide. Press sections from 5 to 75 tons. Send for catalog.

NILSON 4-SLIDE TAKES A TOUGH ONE

Mass production of body trim clips for a leading make automobile proved a complex forming problem. A. H. Nilson's 4-Slide (Model S-4-T) did the job, forming .025" x 3", 1065 C.R.A. steel at 54 strokes per minute! Accurate, fast, and automatic, Nilson 4-Slides keep pace with one of the nation's biggest industries.

A.H. NILSON MACHINE COMPANY

1516 RAILROAD AVENUE, BRIDGEPORT 5, CONN.

Automatic Chain Making Machines : Staple Forming Machines : Wire and Stock Reels : Wire Straightening Equipment : Slide Feeds for Presses

director. The announcement was made by **Russel B. Caples,** company president.

★ ★ ★

Mr. Parkinson has been a counsel for the Anaconda Company and for some of its subsidiaries and affiliates since 1941. He is a native of Salt Lake City, and was graduated from the University of Utah School of Law in 1934.

★ ★ ★

Robert F. Buechner was named assistant to the president of the company. Mr. Buechner, a metallurgist, joined Anaconda Aluminum Company in 1953. He was formerly employed in metallurgical engineering capacities by both Alcoa and Kaiser.

★ ★ ★

Anaconda Aluminum Company is a 95% owned subsidiary of the Anaconda Company.

R B & W Names Binkerd to Eastern Sales Post

Alfred A. Binkerd has been appointed sales representative for **Russell, Burdsall & Ward Bolt and Nut Company** in the Metropolitan New York-northern New Jersey area, according to an announcement by **Harry O. McCully,** vice president in charge of sales. R B & W manufactures a broad line of industrial fasteners in four plants across the nation.

★ ★ ★

Mr. Binkerd will make his headquarters in Englewood, N. J. A graduate of Colgate University, he joined R B & W after serving as assistant Eastern sales manager of Buffalo Bolt Company and vice president of Buffalo International Corp.

Executive Elected by Vulcan Container

George E. McMahon has recently been elected to fill the newly created position of executive vice president of **Vulcan Containers Inc.,** Bellwood, Illinois. The announcement was made by **Vern I. McCarthy, Sr.,** President.

★ ★ ★

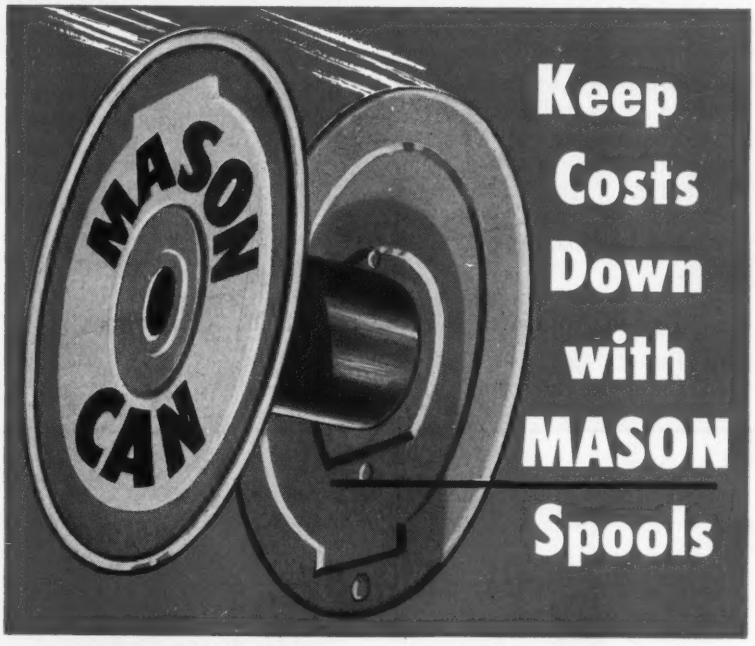
Mr. McMahon has been active in the Steel Shipping Container Industry for the past twenty-four years, twenty-two of which have been with Vulcan. He steps up from his previous position of Vice President in charge of all manufacturing departments and personnel, a post he has held since 1942. He started with Vulcan in its original Chicago plant in the city sales department.

★ ★ ★

Vulcan manufactures the nation's most complete line of Steel Shipping Containers, Drums and Pails for industrial firms from Coast to Coast.

James Given New Post by McKay Machine Co.

The appointment of **Edwin B. James** to the new post of assistant sales manager of the **McKay Machine Company,** Youngstown, Ohio, was announced recently by **A. J. Wardle,** vice-president in charge of sales. He was formerly a sales-engineer in charge of drawbench sales.



MASON *lightweight, non-returnable, lithographed spools for:* **INSULATED WIRE · SOLDER WIRE THERMO-COUPLE WIRE · TV LEAD-IN WIRE AUTOMOTIVE CABLE**

BEST FOR LESS! That's what 175 leading manufacturers say about Mason Spool dependability and performance.

And they help you sell, too! Mason lithography (to meet your specifications) will always assure color uniformity and sharpness of detail for *instant brand identification.*

MASON lightweight, non returnable spools are available in 5″, 6½″, 8½″, and 10½″ head sizes. All sizes are available with 1⅛″ (Dia.) barrel. The 10½″ head size is also available with a 3½″ (Dia.) barrel. Barrel lengths from ⅝″ to 14″.

Tell us about your spool requirements NOW! We'll prove Mason Spools keep costs down—sales up! Telephone East Providence 1-2810 or write:

MASON CAN COMPANY

1949 Dexter Road, E. Providence 14, R. I.
Branch Plant — Greenville, Ohio

To Manage Carboloy's New Diamond Project Section

J. S. Gillespie, formerly manager of product planning, was appointed manager of the newly organized diamond project section of **Carboloy Department of General Electric Company,** Detroit.

★ ★ ★

In his new assignment he will be responsible for transforming laboratory techniques of making man-made industrial diamonds, developed by G. E.'s Research Laboratory, into practical production methods.

★ ★ ★

Mr. Gillespie joined Carboloy in 1936 as an engineer. Before being appointed manager of product planning, he served in several Carboloy district offices, as manager of tool and wear parts sales engineering and as manager of product sales.

Timken Appoints

John Rundt was recently appointed Chief Engineer, Division of Research and Development, by the **Timken Roller Bearing Co.,** Canton, Ohio. At the same time it was announced that **Alva Koptz** had been made Chief Draftsman of the division.

Pittsburgh Steel Man Promoted to New Office

Kenneth F. Maxcy, Jr., formerly advertising manager of the **Pittsburgh Steel Company,** has been appointed to head a newly formed department. He is now Manager of the Production Planning Department.

★ ★ ★

In his new work, Mr. Maxcy will supervise all order processing, central and mill scheduling and in-process steel inventory, to increase the efficiency of the company's service to customers.

L.O.F. Glass Fibers Sales Appointments

Midwest Region sales assignments involving two District Managers and three Field Representatives for the **L.O.F. Glass Fibers Company** were made recently by **J. M. Johns,** Vice President and Director of Sales.

★ ★ ★

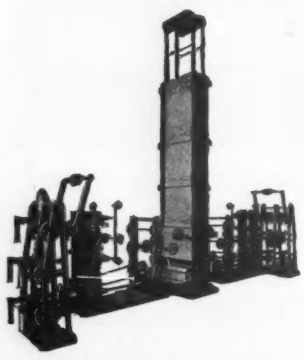
The men assigned will report to **Ken C. Settelmyer,** Sales Manager of the Midwest Region with headquarters at 230 North Michigan Ave., Chicago.

★ ★ ★

The two district assignments were **Arthur S. White** at St. Louis and **Norman C. Plass** at Minneapolis. Field Representatives assigned were **Edward A. Turner,** Chicago; **James T. Gander,** Milwaukee; and **Malcolm C. Brown,** Kansas City.

Copperweld Steel Elects Chairman and President

James M. Darbaker has been elected president of **Copperweld Steel Company** by the board of directors, succeeding **Frank R. S. Kaplan,** who was elected chairman of the board.



ESTABLISHED IN 1855
1955 IS OUR CENTENNIAL

While our business was established in 1855 and incorporated in 1915, our first advertisement in the issue of Wire and Wire Products of September 1926, showing our heavy wire enameling machine of that date, is shown at the left. Our present model #997 with speed variator, electric pre-annealer, circulating system, etc., is illustrated to the right. This latter illustration shows the oven shortened to illustrate the top sheaves.

EST. 1855 AIMCO INC. 1915
"American" AIMCO INSULATING MACHINERY COMPANY
REG. U.S. PAT. OFF.
FAIRHILL AND HUNTINGDON STREETS
PHILADELPHIA 33 PENNSYLVANIA U.S.A.

Mr. Darbaker had been senior vice president of Copperweld since May, 1954 after having served as director of distribution and availability at United States Steel Corporation. Prior to that, he had been associated for many years with operating subsidiaries of United States Steel—had served as general manager of sales for Carnegie-Illinois Steel Corporation as well as manager of operations of the Chicago district for that subsidiary.

Monsanto Makes Two Promotions

Two promotions in the sales department of **Monsanto Chemical Company's Plastics Division** have been announced.

★ ★ ★

Edmond S. Bauer has been named assistant director of sales for resin products and **Thomas W. Sears** has been named sales manager for industrial resins. Both promotions became effective November 1st.

★ ★ ★

Mr. Bauer, who was sales manager for industrial resins prior to his promotion, will be responsible for the sale of industrial, textile and paper resins. Mr. Sears, who formerly was assistant sales manager for industrial resins, will report to Bauer in his new assignment.

Five Electrical Manufacturers Join NEMA

Five electrical manufacturers have joined the **National Electrical Manufacturers Association** (NEMA), it was announced recently by **A. F. Metz,** president of the Association.

★ ★ ★

Their election to membership raises the Association's register of member companies to 577.

★ ★ ★

The new members are: **Electrical Utilities Company,** La Salle, Ill.; **Fansteel Metallurgical Corp.,** North Chicago, Ill.; **Lockley Machine Co.,** New Castle, Pa.; **New England Laminates Co., Inc.,** Stamford, Conn.; and **Resin Industries, Inc.,** Santa Barbara, Calif.

Appointed by Brush Electronics

The appointment of **John H. Harris** as vice president in charge of planning and **Wallace T. Gray** as general works manager has been announced by **Douglas C. Lynch,** president of the Brush Electronics Company, Cleveland.

★ ★ ★

Mr. Harris has been vice president and general works manager for the firm, a division of Clevite Corporation, since 1948. In that post, he directed manufacturing, production control, maintenance and inspection.

★ ★ ★

Mr. Gray was formerly works manager for the Leece-Neville Company, also of Cleveland. Prior to joining Leece-Neville, he served as manager of the RCA Victor Division plant and as factory manager for Thomas A. Edison, Inc., Instrument Division.

(ILLUSTRATED)
42" x 20" x 21"—(4000# cap.)

HEAVY DUTY
BREAK-DOWN REELS

1000#
2000#
4000#
} capacities

Rugged Design including patented DURA-CURL rim, and many other features necessary to provide the *Strength* and *Durability* needed for continued successful performance.

Also complete line of sizes of Modern High Speed Wire Drawing NO-CREV Spools and Reels for both fine and intermediate size wire.

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Mossberg PRESSED STEEL Corporation

18 WEST ST., ATTLEBORO, MASS., U.S.A.

James Day (Machy) Ltd.
28 Maddox St.
London W.I. England

#103

Firth Sterling Appoints Assistant Chief Engineer

Firth Sterling Inc., has announced the appointment of **Wesley R. Sutton** as Assistant Chief Engineer, Carbide Sales Division. He will work with the firm's field service engineers.

★ ★ ★

Before joining Firth Sterling as a carbide service engineer in 1954, Mr. Sutton spent 22 years with a major carbide manufacturer. He began as a toolmaker and advanced through the engineering, methods and production control departments.

★ ★ ★

Mr. Sutton has lectured on carbides and their applications to numerous technical societies, ASTE chapters, and industrial groups throughout the country.

Celanese Names New England Sales Manager

Walter E. F. Mansfield has been named district sales manager, New England District, for textile sales of **Celanese Corporation of America,** succeeding **Bartlett Guild,** who is retiring after 30 years service with the company. Mr. Mansfield has been associated with Celanese in the textile sales field for many years.

Edward Magnuson

Edward Magnuson passed away on October 16, 1955. Born in Kalmar, Sweden on July 4, 1878, Mr. Magnuson went to sea as a young boy. Among the ports of call was the United States and the young man soon made that his adopted land, becoming a citizen in 1913. He worked as a soap maker and devised various formulae which earned him a reputation in the industry. Mr. Magnuson was a pioneer in the detergent field and helped to build several of the leading companies in that field. In 1923 he organized his present firm, the **Magnuson Products Corporation,** Brooklyn, N. Y. and served as its President until his death; he also owned and headed **Canadian Permag Products, Ltd.** in Quebec.

Ernest H. Webb

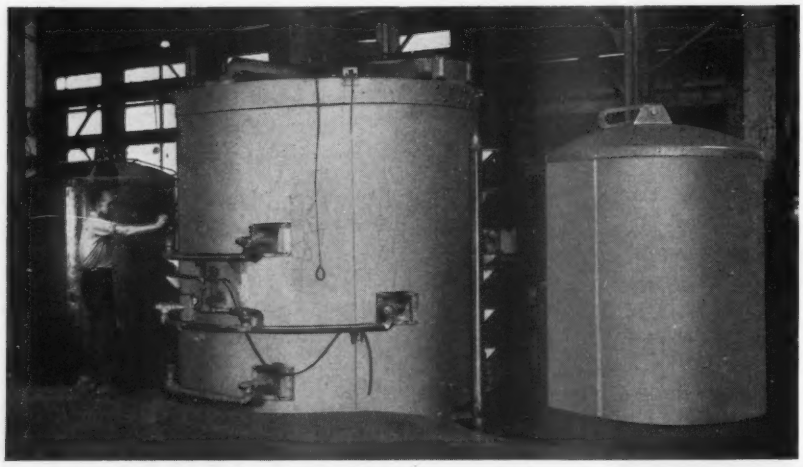
Ernest H. Webb, nationally known pioneer in the manufacture of music wire, stainless steel wire, and needle wire, died recently at New Brunswick, N. J., at the age of 79.

★ ★ ★

Mr. Webb was formerly president and owner of the **Webb Wire Works** in New Brunswick, which is now a division of **The Carpenter Steel Company.** He established the original firm in 1906, and remained as consultant after its consolidation with Carpenter in 1951.

★ ★ ★

During his long career in metallurgy, he was a member of the Iron and Steel Institute of America, the Iron and Steel Institute of Great Britain, and the American Institute of Mining and Metallurgical Engineers.



Bright Annealing Wire Uniformly in ROCKWELL BELL FURNACES

In this Rockwell installation four furnace bases and one gas fired, bell type furnace provide the required operating flexibility of heating, loading and unloading the work. Each base is equipped with a circulating fan to distribute heat uniformly to the charge.

A steel hood is placed over the work and sealed tight. The load of copper product is bright annealed in a protective atmosphere and cooled in the hood.

Rockwell bell furnaces (cylindrical or rectangular) are built to specifications for bright annealing steel and non-ferrous wire in coils or on spools.

Write for Bulletin 432 on Rockwell Wire Mill Furnaces.

ROCKWELL ALSO BUILDS
Batch and continuous furnaces and ovens for annealing, aging, drying, enameling, tinning, glass coating, synthetic coating. Atmosphere generators.

ROCKWELL SINCE 1888 BUILT

W. S. ROCKWELL COMPANY
FURNACES • OVENS • BURNERS • VALVES • SPECIAL MACHINERY
2425 ELIOT STREET • FAIRFIELD, CONN.
Sales Representatives in Principal Cities

TO SELL—ADVERTISE IN
WIRE AND WIRE PRODUCTS
It pays—send for rates
453 Main St., Stamford, Conn.

A Review of Recent Wire Patents

The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.

Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50¢ for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.

No. 2,719,678, TRAVERSING GUIDE FOR WIRE COILER, patented October 4, 1955 by Carl T. Lanstrom, Concord, Calif., assignor to United States Steel Corporation, a corporation of New Jersey.

For winding wire on a spool, the inventor associates a traversing carriage mounted for reciprocating movement axially of the spool to thread the wire thereon in layers, a reversing fluid pressure motor for the carriage and reversing valve mechanism for the motor, together with a device for operating the reversing valve.

★ ★ ★

No. 2,719,689, CLOTHES BASKET HOLDER, patented October 4, 1955 by Lyman J. Umstead, Birdsboro, Pa.

This holder is constructed of wire bent to shape and provides a base portion and holder portion for the basket.

★ ★ ★

No. 2,719,820, METHOD FOR COATING STEEL STRIP, patented October 4, 1955 by William S. Allen, Pittsburgh, Pa., assignor to United States Steel Corporation, a corporation of New Jersey.

A method is disclosed for applying to the steel strip a coating of thin, terne, lead or zinc by an electrolytic coating step followed by a sprayed coating in a non-oxidizing atmosphere and at a temperature to melt the first coating and alloy them with the surface of the strip.

★ ★ ★

No. 2,720,014, SAFETY SNAP FASTENER FOR FISHING TACKLE, patented October 1955 by Ferris H. Caldwell, Canton, N. Y.

The fastener is constructed of a single length of wire bent to shape.

★ ★ ★

No. 2,720,227, METHOD OF MANUFACTURE OF BARBED WIRE, patented October 11, 1955 by Raymond F. Stockton, Sunland, Calif.

This method comprises providing a pair of parallel strand wires and placing a longitudinally co-extensive, previously sinuously curved barb component wire in superimposed relation on these strand wires with at least part of the loops of the barb component wire disposed laterally beyond one of the strand wires, then welding the barb component wire to this one strand wire at points of intersection therewith, then cutting the laterally projecting loops with resultant formation of barb points on the portions of the barb component wire which are welded to the one strand wire, and finally bending the barb points laterally of the plane of the pair of strand wires.

★ ★ ★

No. 2,720,371, SUPPORTS FOR GARDEN HOSE, patented October 11, 1955 by Frank G. Campbell, Arlington County, Va.

These supports are each formed of a single piece of heavy wire.

★ ★ ★

No. 2,720,675, CARRYING HANDLE, patented October 18, 1955 by Vilho Johannes Nurmi, Helsinki, Finland.

A bail handle is disclosed comprising a single length of wire.

★ ★ ★

No. 2,720,907, WIRE STRAIGHTENER, patented October 18, 1955 by Peter E. Seibel, West Hempstead, N. Y., assignor of one-half to Abraham Borut, New York, N. Y.

The apparatus includes a cooperating thimble in threaded engagement with the interior of a cylinder whereby the cylinder and thimble may be expanded and contracted, with the thimble and cylinder each having a circular track with an inner race adapted to run in the track, said thimble having a second circular track with an inner race

Standardize on ACROPAK* Spools!

Only ½ the Weight!

YET STRONG, TOUGH, RIGID . . *LONGER LIFE*

ACROPAK Spools will help you cut wire packaging costs because they give longer service, require less maintenance and cost less to ship. They're strong. They'll take repeated shippings and still run true on the arbor. They're machined to close tolerances. You can run them at high production speeds with fewer snags, less toe-out and minimum end breakage.

THEY CUT YOUR SPOOLING COSTS

Best proof of ACROPAK superior performance are the millions of these spools now used by the biggest names in the wire industry. We've proved it to them—let us prove it to YOU.

- Light Weight
- Precision built
- Reduced cost
- Longer life
- Extra strength
- Dynamic balance
- Greater production
- Low cost reconditioning
- Less maintenance
- Attractive packaging

★ We also make a complete line of heavy-duty shop processing STEEL SPOOLS built to the same high standards of accuracy and rigidity as the famous Acropak aluminum spools.

ACROMETAL PRODUCTS INC.

Division U S Bobbin and Shuttle Co., 616 Fifth Street N., Minneapolis 1, Minn.

adapted to run in the track. There are also rotors adapted to spin in an expanded concentric circle around the longitudinal axis through the center of the cylinder and thimble. The races being adapted to support the wire to be straightened in position at approximately the longitudinal axis through the center of the cylinder and the rotors being adapted to support a portion of the wire between the races and spin it in an expanded concentric circle around the longitudinal axis of the wire whereby the wire is successively bent in all directions around its axis and straightened.

★ ★ ★

No. 2,721,038, COIL WINDING MACHINE, patented October 18, 1955 by Harold C. Pasini, Westwood, N. J., assignor to George Rattray & Co., Inc., Jamaica, N. Y., a corporation of New York.

This apparatus is for producing helical windings of non-uniform spacing, with the spacing to be accurately controlled from point to point.

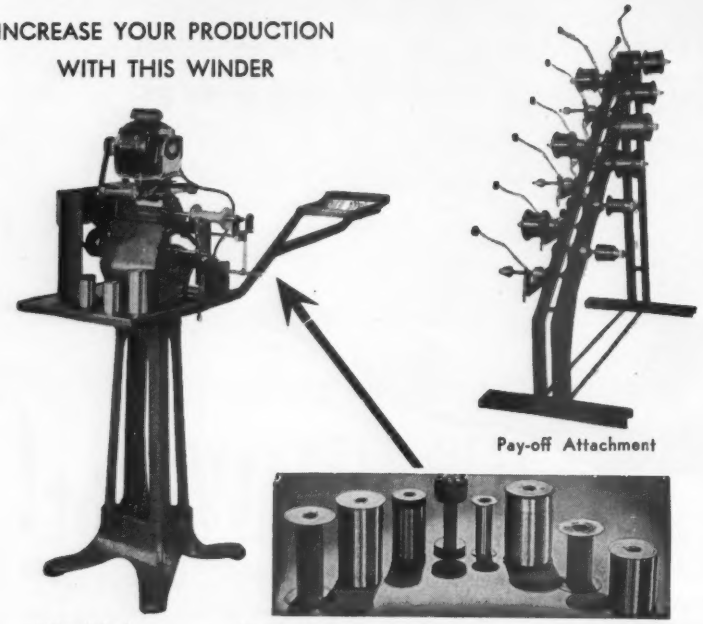
★ ★ ★

No. 2,721,653, WIRE FABRIC PACKAGE, patented October 25, 1955 by Ben B. Billinger, Norwalk, Conn., assignor to The Gilbert & Bennett Mfg. Co., Georgetown, Conn., a corporation of Connecticut.

A unit package is provided comprising a two-coil strip of reticulated wire fabric uninterrupted throughout its length each of the coils consisting of a substantial length of this strip spirally wound, one end of the strip lying at the core of one of the coils and the other end of the strip lying at the core of the other coil, the outside layer of one of the coils being joined to the outside layer of the other of the coils by a portion of strip intermediate its ends.

STANDARD UNI-DRIVE WIRE WINDER

INCREASE YOUR PRODUCTION
WITH THIS WINDER



Pay-off Attachment

Wire Winder

Various types of supply packages that may be wound on Standard Uni-Drive Wire Winder.

PAYOFF

Our payoff attachment is made with self-aligning ball bearings and a compensating attachment to control the tension of each end. Applies same tension when spool is empty as when full.

The new Uni-Drive Winder with Payoff Attachment is new in design and incorporates several improved and tested features. Production is stepped up through increased speed. It produces smooth, even and accurately wound spools of wire in single or multiple ends. All strands parallel—no over or under-winding. Automatic Stop-Motion controls each strand. Compensating attachment produces perfectly controlled tension. Traverse adjustable from 1¾" to 5½" between spool heads without changing cam. Designed especially for winding wire to be braided and shielded for electrical conductors up to ¾" diameter.

Payoff can be equipped with Carboloy Guide Inserts at additional cost.

STANDARD MILL SUPPLY COMPANY
PAWTUCKET, RHODE ISLAND, U.S.A.
1064-1080 Main St.
PAwtucket 3-1534 — 3-1535 — 3-1536

Describes Copper Bar Furnace

The October issue of "The Burner Box", published by the **W. S. Rockwell Company,** 196 Eliot St., Fairfield, Conn., contains an illustrated article describing an atmosphere furnace to heat treat copper wire bars continuously, so that they can arrive at the rolling mill scale-free, unmarked and undamaged.

★ ★ ★

A copy of this publication may be secured by writing to the company at the address above. Ask for Volume 9, Number 5.

Du Pont to Build Plant in Texas

Plans for the construction of the first full-scale plant for the manufacture of "Hypalon" chemical rubber at Beaumont, Texas, have been announced by the **Du Pont Company.**

★ ★ ★

The new production facility will be located at Du Pont's Beaumont Works which started operation a year ago with the manufacture of methionine, an essential amino acid used as a poultry feed supplement.

★ ★ ★

"Hypalon" chlorosulfonated polyethylene is a synthetic rubber developed by Du Pont research. Limited quantities for trade evaluation and market development purposes have been supulied by an interim plant at Belle, W. Va.

★ ★ ★

The outstanding characteristics of "Hypalon" are its color stability and resistance to heat, chemicals, oxidizing agents and weather. It is suitable for use in wire coverings, chemical tank linings and protective coatings, as well as many other applications.

Stress Corrosion and Relaxation of High Carbon Steel Wire for Prestressed Concrete

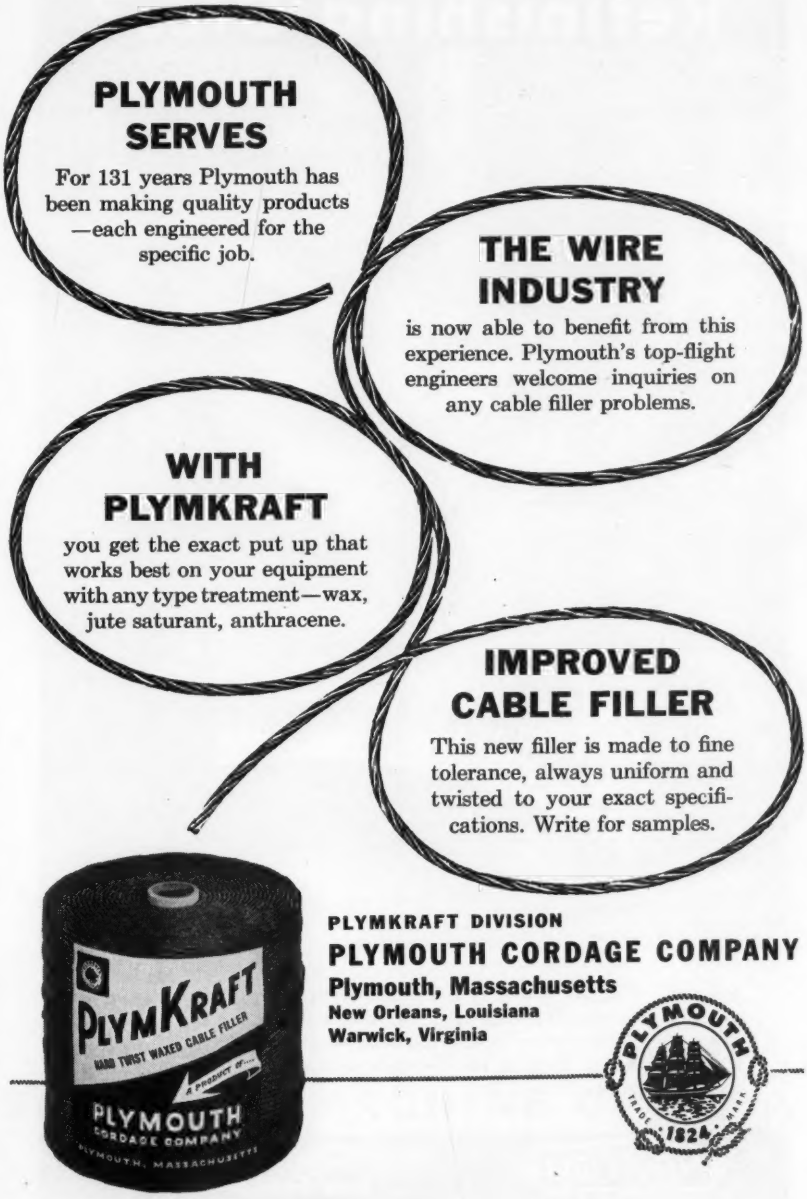
(*Continued from page* 1479)

at a temperature of 950°F in the one case and of 878° F in the other. It can be seen that the curves 7 and 8 are not different from each other.

* * *

From this diagram another fact is confirmed already previously mentioned by other authors. While at initial stresses of 70-75% and less the unrelieved wires and strands do creep more than the relieved ones, a reversal of this behaviour is found at higher stresses. The usual stresses, however, are likely to keep within the limits above mentioned, and relieved wires, therefore, are to be preferred. Decisive for this behaviour is the level of the elastic limit. As is well known, a high elastic limit which has been raised previously by stress relieving or heat treatment, is lowered considerably if the wire is plastically deformed by stretching, bending, torsion, cold heading or the like. Since creeping is dependent upon the same factors, a high elastic limit will be of no advantage in cases where the initial stress is equal to or exceeds the stress corresponding to the elastic limit. In a wire which has not been stress relieved, the elastic limit is raised by plastic deformation, which is the reason for the stretching recommended so frequently. In the case of stress relieved wires, the elastic limit is already raised and therefore a considerable creep enters if the initial stresses are above the elastic range. Looking at the values given for the elastic limit, it will be observed that the values are 75 to 79% of the UTS for the stress relieved material, as compared to 36% for the unrelieved material. If it is desirable to obtain at any rate low relaxation values, it results that the elastic limit must be raised by suitable means to a level which distinctly exceeds the initial stress to be employed. As a comparison, curve 10 shows the behaviour of a flat rolled oil-tempered "Neptune" steel wire with oblique ribs. On account of their high elastic limit, oil-tempered wires show only a small amount of creep at ordinary stresses. They behave, however, like drawn and stress relieved wires when the stresses to which they are exposed exceed the elastic limit. In the "German Tentative Standards for the Approval and Acceptance of Steels to be used in Prestressed Concrete" (DIN 4227) only 1000 hour tests at constant load are provided. Therefore a great number of creep strain values are available, which were obtained by this method.

Fig. 15 shows the creep of unrelieved steel wires and strands at various loads. Whereas the 2-wire strand reacts in about the same manner as a single wire, the amount of creep which is found in a 7-wire strand is distinctly greater, especially in the lower stress range. This behaviour corresponds to the values which were found in the relaxation tests. The creep value after 1000 hours is about 0.04% at loads of 60% of the UTS and about 0.08% at 75%. In these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experiments the first reading of the creep was taken at the end of the 6th minute after the load had been applied.

★ ★ ★

The following **Fig. 16** gives results of 1000 hours creep tests with several stress relieved steel wires. The trend of the curves, however, is more uniform. Compared to the previous Fig. 15 the curves are steeper which means that at high loads wires which are stress relieved creep more than not relieved wires. The creep curves of 0.350" steel wires with rolled on threads are of great interest. These wires with an UTS of 101-108 tons/sq. in. were tested together with the anchorage by fixing the dial indicator to the end of nuts. It was found that no measurable creep of the thread or the nuts occurred, since the same amount of elongation resulted as in the unthreaded wires. For unalloyed patented drawn and stress relieved steel wires is to be reckoned with a creep strain of 0.01% after 1000 hours at a stress of 60% of the UTS and with 0.08% at 75% on an average.

★ ★ ★

The relaxations found in these experiments are generally in good agreement with the results published so far in these cases in which the relation of the elastic limit to the UTS is about the same. It is possible in my opinion to predict much about the creep behavior or the relaxation to be expected from the level of the elastic limit, if the amount of the initial stress is known. For steel qualities without a distinct yield point —to which belong the wires and strands which were examined in this investigation—it can be assumed, that the creep- and relaxation-limits respectively coincide approximately with the 0.01-limit. From the experiments the conclusion can be drawn that raising the elastic-limit by stress relieving, tempering or stretching only in those cases is of advantage in which the elastic-limit resulting from this treatment is distinctly higher than the actual working stresses. Steels treated in this manner therefore always should favour a low relaxation for the usually approved maximum stresses of about 55-60%. For stresses higher than the above mentioned drawn wires which have not been heat treated afterwards, can be successfully employed. In addition to that they offer a greater advantage due to the fact that by exceeding the 0.01 limit the stresses are balanced when in practice differences in stresses are caused by various conditions.

★ ★ ★

Nowadays one frequently finds two opinions which give preference either to precise creep tests in the laboratory using exact measuring devices or rather to simpler relaxation tests which better imitate practical conditions. Therefore the question arises as to which kind of creep tests should be preferred. In fact people who use prestressed steel primarily are interested in the question, what loss by relaxation must be taken into account with a particular steel quality and a particular stress, and what price they will have to pay for the remaining prestress. To know the relaxation is of more

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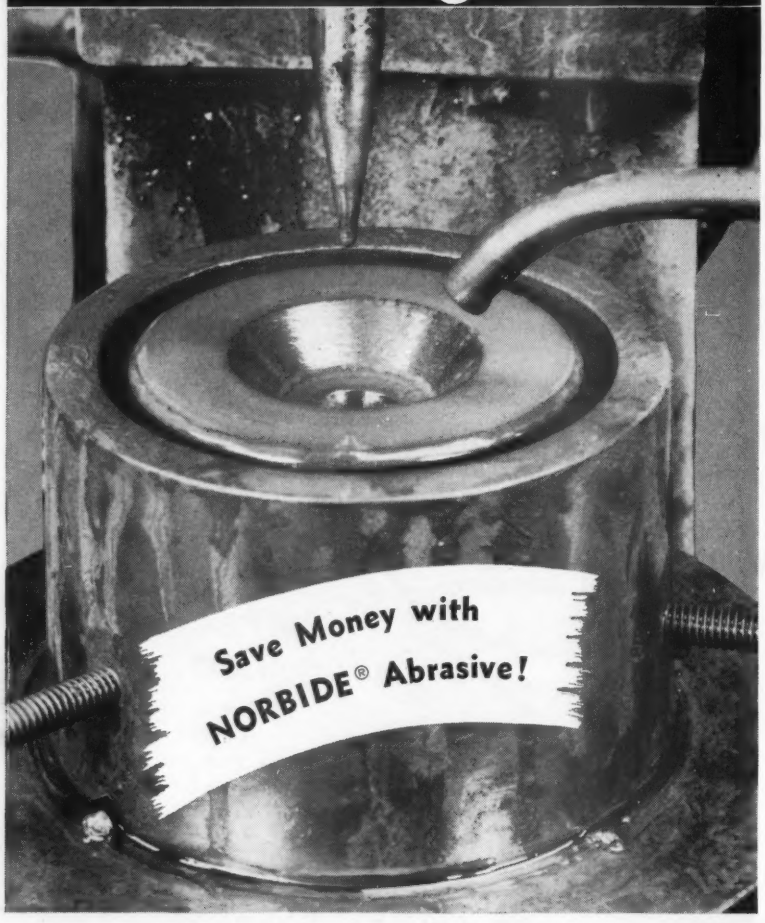

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practical value than the knowledge of the creep strain which results from tests under constant load. In the standards for approval and acceptance, therefore, not only more use should be made of relaxation tests than before, but also the testing equipment and procedures should be standardized so that results will be obtained which can be better compared.

★ ★ ★

The questions dealt with here of stress corrosion and relaxation are very important for choosing a steel which is suited for use in prestressed concrete. It is not possible to state that one particular steel quality generally is superior to another. It seems to be better to know as exactly as possible the typical properties of the steels and to select them according to the conditions under which they are to be employed. It may happen that a somewhat greater relaxation or lower resistance to stress corrosion can be conceded because the conditions prevailing in a particular case make this possible. However, in any way further investigations in this field should be carried out under test conditions as uniform as possible to enlarge our stock of knowledge and to improve our steels for prestressed concrete.

Summary

The resistance to stress corrosion and the relaxation of several high tensile steels for wires and strands to be used in prestressed concrete have been investigated. The results showed that oil tempered wires are considerably less resistant to stress corrosion than the drawn and stress relieved steel wires which are usually employed. The reason for this behaviour is traced back primarily to the martensitic condition of the steel (high inner stresses) and its crystal structure (great number of grains boundaries). Fatigue tests confirmed that the stress corrosion attack in drawn and stress relieved steels was considerably less, even at much longer corrosion times. It is recommended to make use of oil-tempered steel wires only where stress corrosion can not occur.

The relaxation at various stresses after 1000 hours was investigated for drawn as well as drawn and stress relieved wires and strands; at stresses exceeding 65-70% of the UTS a different behaviour was found. At stresses below 70% of the UTS drawn and stress relieved wires showed themselves to be particularly suited. A favourable influence of a low reduction of area in drawing was found, but further experiments in this direction are recommended. Low Mn and Si alloyed carbon steel wires in the stress relieved condition exhibit particularly favourable creep behaviour.

★ ★ ★

Finally further investigations under conditions as uniform as possible are necessary.

References

1. **W. O. Everling, Jearb. Amer. Iron Steel Inst. 1954 S. 185/205**
2. **G. T. Spare, Wire and Wire Prod. 29 (1954) H.12, S.1421/24, 1492/93**
3. **W. Raedeker, Stahl u. Eisen 73 (1953) S.485-492**

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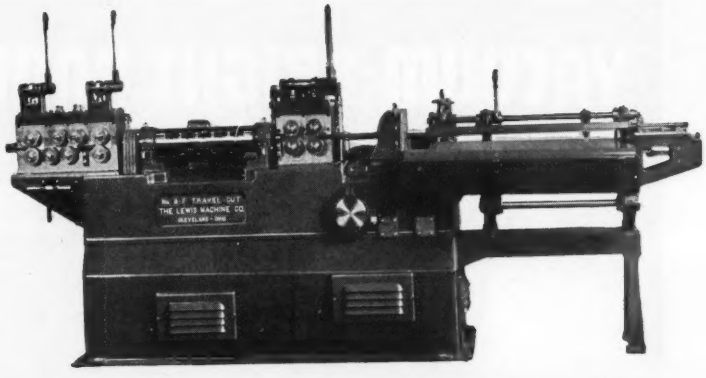

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Total Number of Companies Included 134

SEPTEMBER - 1955
Month

SHIPMENTS OF STEEL PRODUCTS
ALL GRADES INCLUDING CARBON, ALLOY AND STAINLESS
(Net Tons)

Covering Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or for Resale)

Steel Products	Items	Current Month 1955 Carbon	Alloy	Stainless	Total	Percent of Total Shipments	Prior Year (1954) Percent of Total Shipments	Year to Date 1955 Carbon	Alloy	Stainless	Total	Percent of Total Shipments	Prior Year (1954) Percent of Total Shipments
Ingots	1A	46,184	17,835	1,982	66,001	0.9	0.5	295,440	129,033	19,643	444,116	0.7	0.5
Blooms, slabs, billets, tube rounds, sheet bars, etc.	1B	170,054	50,825	2,279	223,158	3.0	2.3	1,654,126	407,656	14,701	2,076,483	3.3	2.3
Skelp	2	17,013	-	-	17,013	0.2	0.3	131,789	-	-	131,789	0.2	0.2
Wire rods	3	105,573	2,009	549	108,131	1.5	1.3	842,649	17,162	6,111	865,922	1.4	1.2
Total Semi-Finished	...	338,824	70,669	4,810	414,303	5.6	4.4	2,924,004	553,851	40,455	3,518,310	5.6	4.2
Bars—Hot rolled (incl. light shapes)	14	547,637	186,526	4,497	738,660	10.0	9.4	4,772,759	1,586,135	33,192	6,392,086	10.2	9.6
Bars—Reinforcing	15	186,165	-	-	186,165	2.5	3.0	1,574,315	-	-	1,574,315	2.5	2.8
Bars—Cold finished	16	128,509	24,815	4,572	157,896	2.2	1.9	1,112,167	214,981	39,254	1,366,402	2.2	1.9
Tool steel	17	1,250	8,168	-	9,418	0.1	0.1	11,165	71,877	-	83,042	0.1	0.1
Total Bars and Tool Steel	...	863,561	219,509	9,069	1,092,139	14.8	14.4	7,470,406	1,872,993	72,446	9,415,845	15.0	14.4
Standard pipe	18	253,160	232	5	253,397	3.4	4.3	2,193,925	710	7	2,194,642	3.5	3.7
Oil country goods	19	184,082	38,173	-	222,255	3.0	3.6	1,545,088	311,826	-	1,856,914	3.0	3.8
Line pipe	20	294,701	-	-	294,701	4.0	4.5	2,280,866	30	-	2,280,896	3.6	4.6
Mechanical tubing	21	54,567	25,163	370	80,100	1.1	1.1	507,922	185,950	3,639	697,511	1.1	1.0
Pressure tubing	22	19,469	1,373	1,350	22,192	0.3	0.4	167,246	18,276	10,970	197,492	0.3	0.5
Total Pipe and Tubing		805,979	64,941	1,725	872,645	11.8	13.9	6,695,047	517,792	14,616	7,227,455	11.5	13.6
Wire—Drawn	23	265,436	4,184	2,769	272,389	3.7	4.0	2,291,215	33,990	23,399	2,348,604	3.6	3.7
Wire—Nails & staples	24	58,321	-	-	58,321	0.8	1.1	523,233	-	1	523,234	0.8	0.9
Wire—Barbed & twisted	25	5,161	-	-	5,161	0.1	0.2	101,974	-	-	101,974	0.2	0.3
Wire—Woven wire fence	26	21,423	-	1	21,424	0.3	0.4	269,098	-	2	269,100	0.4	0.5
Wire—Bale ties	27	3,687	-	-	3,687	-	0.1	53,662	-	-	53,662	0.1	0.1
Total Wire & Wire Products	...	354,028	4,184	2,770	360,982	4.9	5.8	3,239,182	33,990	23,402	3,296,574	5.3	5.5
Total Shipments (1955)	...	6,821,600	497,375	59,272	7,378,247	100.0	xxx	58,124,004	4,047,841	500,758	62,672,603	100.0	xxx
Total — Prior Year (1954)	...	4,688,313	280,117	35,792	5,004,222	xxx	100.0	44,446,813	2,681,307	322,053	47,450,173	xxx	100.0

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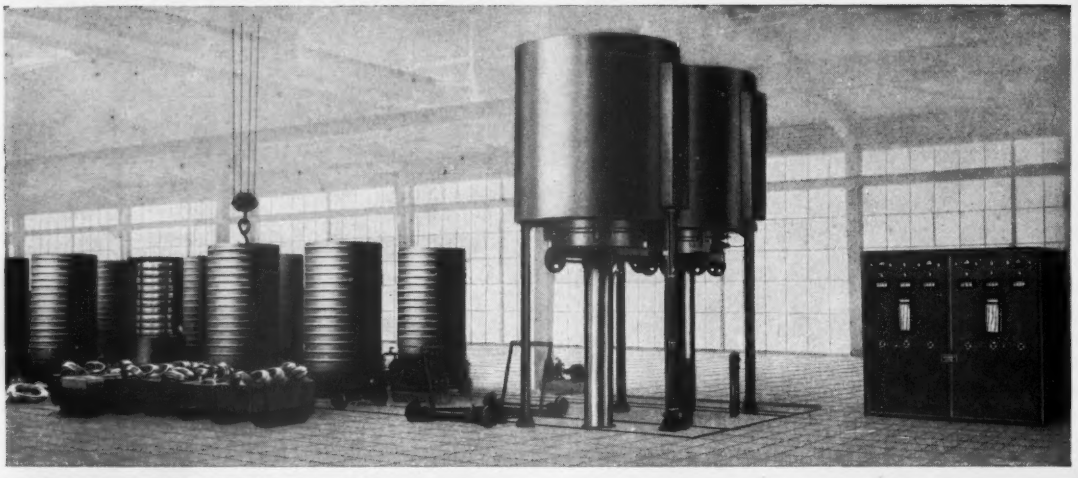

BRAUN-ANGOTT

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A Viking Nail 1100 Years Old

(*Continued from page* 1503)

a melting point near 2480° F (1360° C), this being progressively lowered by combinations with S, Mn, and so forth; and the inclusions in Figure 7 seem to be almost entirely iron oxide, and partly plastic when worked.

★ ★ ★

Next, the metal structure places definite lower limits upon the temperatures of the forging operations. Lack of deformation in the ferrite means that forging had ceased before cooling to ~1650° F (~900° C); and this is confirmed by the similar lack of deformation evident in the primary austenite boundaries. Working of the nail was therefore in the approximate range of 2000° F ± 200° (roughly 1100° C ± 100°), and it was not continued much below 1800° F (~980° C). Comparison of the Widmannstatten structures with the stepwise operations illustrated by Carpenter and Robertson in their text **Metals** shows that the nail had been cooled about 450° F (250° C) per minute near the tip, and approximately 270° F (150° C) per minute at the shoulder. This would seem to prove that the nails were not quenched, but were merely air-cooled. In fact, these rates are almost slow enough to suggest the nails might have been dropped in a dry bucket, or perhaps in a pile on the floor where they were cooled a little slower than is customary for air-cooling.

Conclusion

In closing this discussion of Viking metallurgy, it might be mentioned that the principal source of iron ore in those days was from bogs and lake bottoms, the bog ore or **myrmalm** being particularly common in southern Sweden, and the lake ore or **sjomalm** throughout north-central Scandinavia. Use of the rock ores belongs to a later date. Also, it is an interesting anecdote that the Viking **Sagas** frequently speak of the failure of an iron sword to "bite". For example, an Icelandic Saga tells of Steinthor having to straighten his blade under foot after each stroke. If that is to be taken as illustrative of Viking Age ferrous metallurgy, then the present instance of superior nail-making deflates to a matter of chance!

Acknowledgment

This study would not have been undertaken if Mr. L. F. Weitzenkorn had not turned over to the author the nail given him by Dr. B. Egeberg; and it could not have been carried through to such interesting results without the further cooperation of Dr. Egeberg, Dr. T. Althin Mrs. C. Blindheim and Mr. L. Smedstad of Universitetets Oldsaksamling in Oslo, Professor E. N. Hartley of the Massachusetts Institute of Technology, and Frederick K. Landgraf, Jr., formerly of of the Tekniska Museet in Stockholm, the authors's Laboratory staff.

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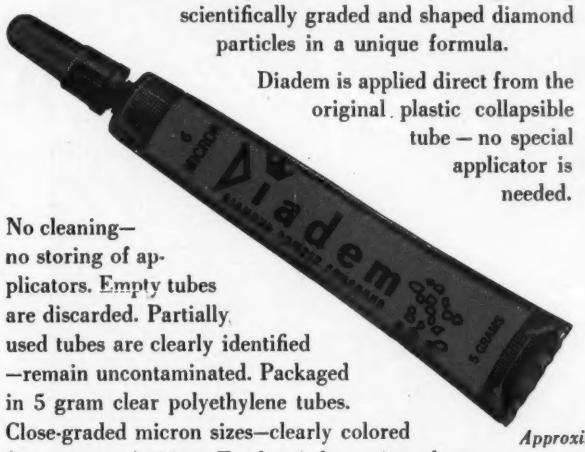

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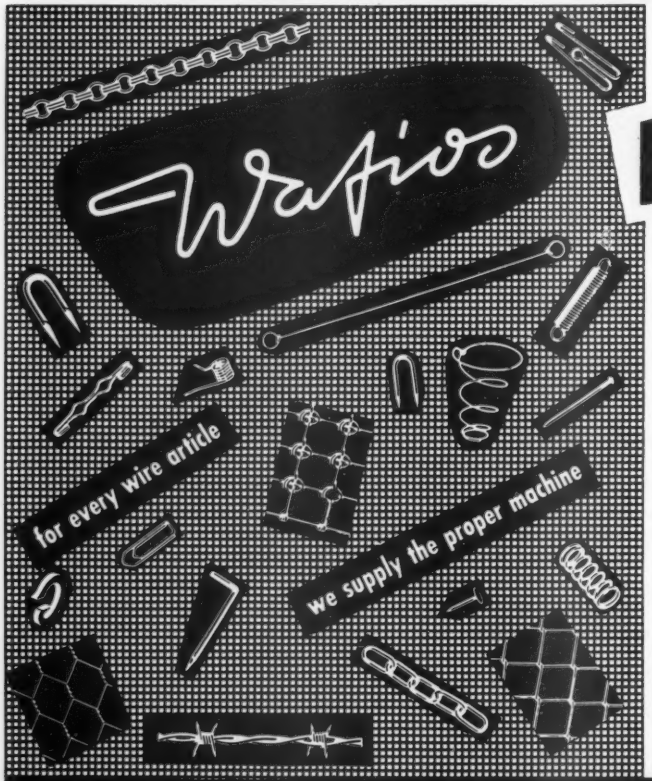

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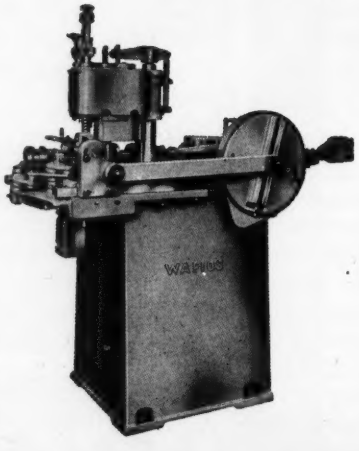

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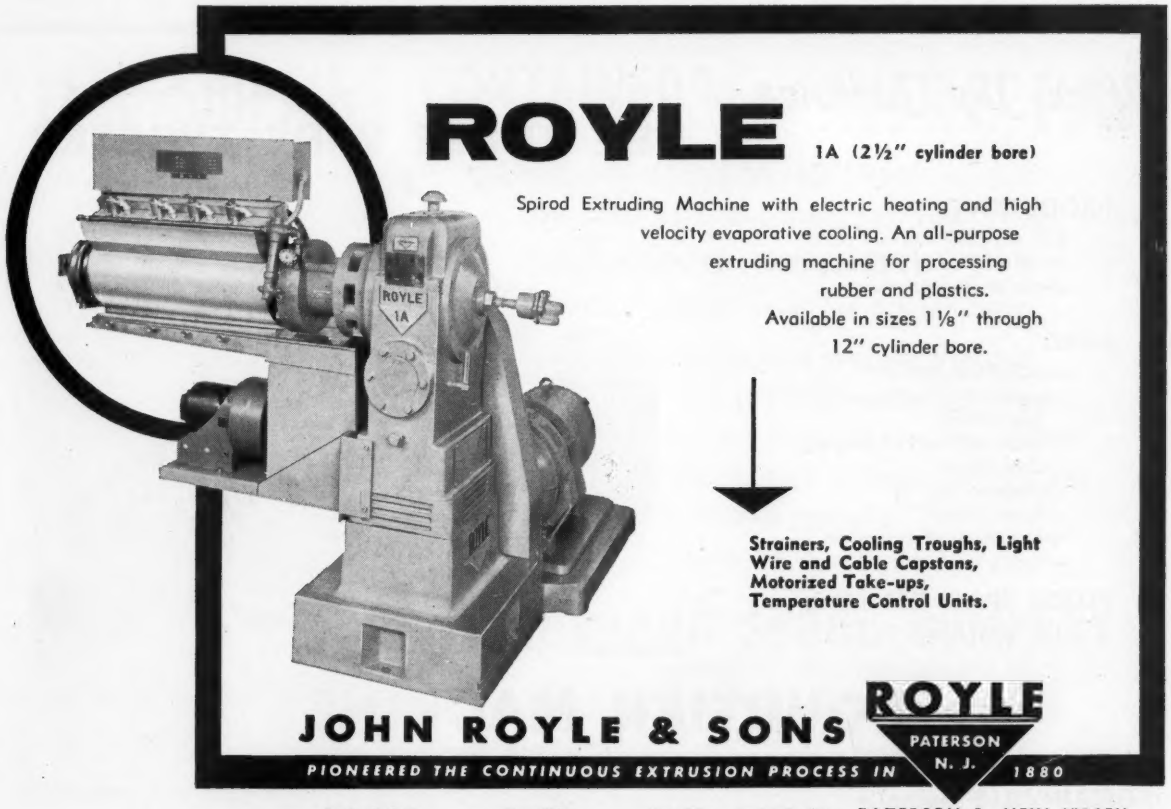
1954	70,143	30,850	100,993	8,518	6,477	14,995
1955:						
January	88,312	28,841	117,153	10,123	4,920	15,043
February	81,021	29,994	111,015	8,278	6,295	14,573
March	94,260	26,351	120,611	10,332	7,453	17,785
April	85,118	26,230	111,348	11,076	6,452	17,528
May	96,549	30,575	127,124	11,725	6,034	17,759
June	89,444	28,195	117,639	11,642	7,190	18,832
July	21,294	21,272	42,566	7,412	3,525	10,937
August	55,824	23,081	78,905	8,790	4,633	13,423

COPPER STATISTICS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Wire Rod Descaling in Germany

(*Continued from page* 1497)

only as an advantage, since it relieves the descaling operation by blasting and hence enables a faster run of the plant.

4. Results of the Descaling By Shot-Blasting

When descaling the wire by chemical methods it is treated normally in the form of coils. Contrary to this, when descaling by shot-blasting the continuous method ensures the uniform treatment of the surface of the wire on all sides. It is evident, therefore, that the descaling by abrasives must be better than the chemical cleaning. For the same reason a second advantage results: the loss in weight of the wire must be less as compared with the chemical process. Eisenhuth **(Stahl und Eisen,** August, 1955) has determined the gain with mechanical descaling by exact tests with 3.7 kgs/ton. I personally think that for long the gain can be estimated a 5 kgs/ton when descaling by shot-blasting.

* * *

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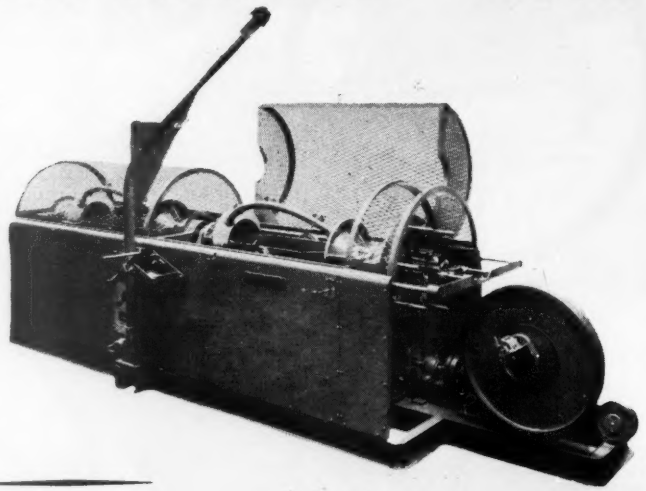

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The wire descaled in the plant as described was drawn later on in high-speed drawing machines with a velocity of 1500 and 2000 ft/min. of the finishing blocks. Up to now there have been no disadvantages. Even the tests of galvanizing these wires subsequently brought about no differences whatever as compared with pickled wires. We are entirely convinced that also in permanent operation there will be no particular difficulties. The months to come shall be used to determine the best conditions of operation for the plant as regards rate of running speed, size and type of the cut-wire and the subsequent surface treatment (liming, etc.).

★ ★ ★

We expect, however, to-day that —after this further proof — we shall be able to build shot-blasting plants of an improved design which will enable us to abandon the pickling plant to a large extent within a period of about a year. We are encouraged to this expectation by our considerations we have made on the economic efficiency of this new method. We are estimating the prime cost of the plant as above:

	Cost per (metric) ton of wire rod in DM
1) Cut-wire, consumption about 1 kg/ton	2.— DM
2) Spare parts	0.50 "
3) Repairs	0.10 "
4) Electric current consumption for shot-blasting and drawing-through the wires about 30 kWh	3.00 "
5) Wages	3.20 "
6) Depreciation	1.20 "
Total about	10.— DM

★ ★ ★

Hence results that the prime cost of this plant would be considerably less than the costs of our existing old pickling plant.

★ ★ ★

In concluding my report allow me to make some personal remarks. The motive of my paper of to-day is first of all the desire to give the experts of the American Wire Industry a report on a new development within the wire industry of Germany. I hope that with the one or other statement I have told you something really new to you. As for myself, I have been in your great country already twice and each time I had the opportunity of becoming acquainted with new and interesting technical equipment, the same opportunity as has been granted also to many of my countrymen during the years past. It is, therefore, a feeling of gratitude that has led me to this convention to give you my report to-day. It has always been my opinion and will be so in future that such an exchange of ideas should serve but to promote the progress of technics and mankind.

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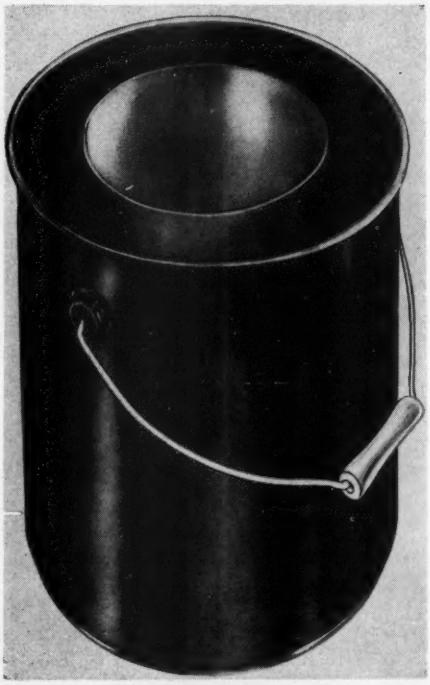

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Carboloy Develops Process for Applying Carbide Layers to Steel

A method of applying thin layers of tungsten carbide to steel surfaces, developed by engineers of **Carboloy Department of General Electric Company,** Detroit, is reported to form a metallurgical bond with the base material.

★ ★ ★

The technique, still in appraisal stages, is said to be different than other methods developed for carbide coating in that it provides a truly sintered carbide structure.

To date, Carboloy engineers have been successful in coating such items as pickup pins, capstan rings, drill jig bushings and cylinder linings, the coatings being applied in thicknesses up to 0.030-inch.

★ ★ ★

Besides providing coated parts with all the wear retarding qualities of cemented carbides, the method may also overcome certain designing limitations associated with solid carbide parts.

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Advantages for Phosphate Coatings in Fastener Forming

(*Continued from page* 1493)

In each of the above listed examples as well as others noted during the work, we feel that the better lubrication supplied by the phosphate coating caused better metal flow and thus alleviated a special or local problem.

★ ★ ★

In line with these special effects, it should be noted that the breakage of kick-out pins was either greatly reduced or eliminated on several items. One 7/16 inch by 20 special flat head bolt made from 1010 steel using alloy heat treated dies usually averaged breakage of six kick-out pins in an order of 50 to 60 thousand pieces. No pins were broken using phosphated rod in this job.

C. Tool Life

If anything resembles hunting for a needle in a haystack it is the collection of data on tool life in a complex, high production factory. We have collected and are continuing to collect considerable information on production versus tool life and would like to present some of the needles from this haystack of information.

1. With Hardened Alloy Steel Tools

The first group of examples represent the work done with special bolts, screws, and rivets where hardened alloy steel was the tool material in use.

★ ★ ★

A 3/8 inch by 7/8 standard rivet of 1010 steel which is pictured in Figure 5 gave an average tool life of 180,500 pieces per die using the die box lubricant on pickled rod. The highest run on any particular die was 256,000 pieces. When phosphated rod was used, one die produced 647,000 pieces, more than three and a half times as many as average.

★ ★ ★

A 5/16 inch by 24 special flat head shoulder bolt of 1010 steel showed an average die life of 26,-

000 pieces per die using phosphated rod. Previous runs using conventionally lubricated rod averaged between 5,000 and 8,000 pieces per die. This represents a 3 to 5 fold increase.

★ ★ ★

53,000 hex head cap screws of 1038 steel were made on one die with phosphated rod. At the finish of the order, the die remained in good condition. Using other coatings, four dies were generally required for an order of this size, an average of 13 to 14 thousand pieces per die.

★ ★ ★

The 7/16 inch special hex head shoulder bolt shown in Figure 6 is made from 1041 steel and over 250,000 pieces per die were produced using phosphated rod. We do not have accurate figures on runs with other lubricants in use, but the comments of operators and foremen indicate the improvement to be substantial. Part of the reason for the higher tool figures on this part probably lies in the fact that the surfaces of the tool subjected to the highest friction and pressure are made of carbide, although most of the tool is of hardened alloy steel.

★ ★ ★

A 1/4 inch by 20 hex machine bolt of 1018 steel showed 13,000 pieces per die when another lubricant was used. Phosphated rod used on the same job showed an average of 28,000 pieces per die. It is interesting to note that the tool life using carbide averaged only 28,000 pieces per die with conventional lubrication.

★ ★ ★

Figure 7 shows a 1/2 inch by 2 1/8 hood bolt of 1010 steel which gave excellent results. So did the 3/8 inch by 2 29/32 special upset bolt of 1038 steel shown in Figure 8 and the .338 hex washer head shoulder bolt in Figure 9.

★ ★ ★

Many other similar examples could be shown and similar results reported showing a substantial increase in hardened alloy tool life.

2. With Carbide

Carbide tools generally last much

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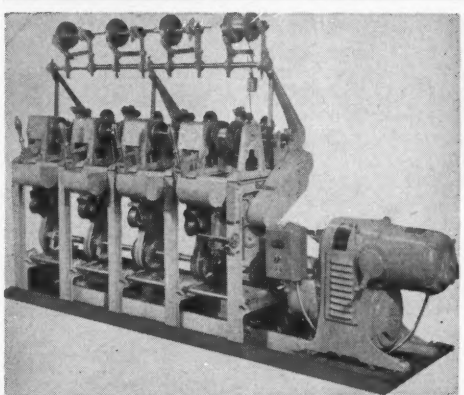

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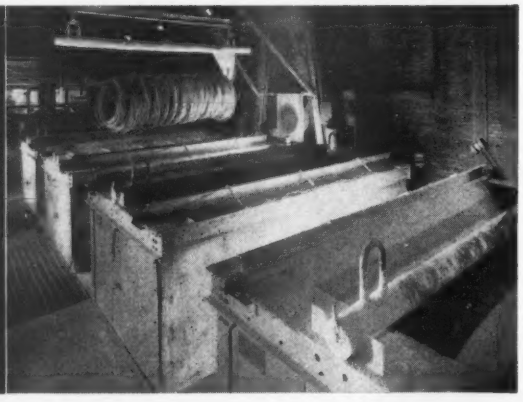

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longer than do high carbon, high chrome hardened steel tools.

★ ★ ★

Quite frequently an average carbide tool life lies in the millions of pieces and even on some difficult jobs is well over 250,000 pieces. For instance, the tool life on several types of bolts is shown in Figure 10.

★ ★ ★

We are at present comparing phosphated material with the conventional lubricants to determine an advantage, if any. In most cases, we are still running on the first die and the number of pieces run to date compares closely with Figure 8.

★ ★ ★

One item deserves mention in this connection, however. A 5/16 inch by 24 hex head shoulder bolt of 1018 steel showed a strikingly low carbide tool life of 67,000 pieces per die. Using phosphated rod, one die produced an order of 105,000 pieces, and another produced an order of 194,000 pieces. Both dies remained in good condition at the end of the run. This is hardly conclusive but indicates a tendency to promote better carbide tool life.

3. Cap Screws

Investigation broadened to include standard items regularly produced. Results on high carbon heat treated cap screws from 1/4 inch to 7/8 inch diameter were evaluated first. Most of the stock was 1038 although some 1041 and some 1018 were processed.

★ ★ ★

Due to the fact that the investigation on cap screws began so recently, results are not yet conclusive. Indications at present are that using hardened alloy tools, 22,000 to 35,000 pieces per die can be produced with phosphated rod. Lime or stearate coatings produce between 10,000 and 20,000 pieces per die.

★ ★ ★

What complicates the determination of tool life in the case of the cap screws is the small number

of pieces per order. Frequently the die is in excellent condition at the end of the run and we lose track of it when the machine is changed over to the next job. We intend to continue our efforts on cap screws for a possible later report.

Lubrication

A word about lubricants and the results of various tests on lubricants which were run during this investigation is in order. First, in reference to nut forming, soap type lubricants, applied in the pickle house after phosphating are superior to the circulated oil of the nut former in protecting the surface of the nut. Second, no striking advantage of the immersion lubricant over the die box lubricant could be noted. However, it was definitely established that rod which was pickled, phosphated, and lubricated in the pickle house could be drawn, headed, extruded, etc. without resort to die box lubricant, and with results equal to those from phosphated rod drawn through the die box lubricant. Third, due to the general wastefulness in handling die box lubricants, there is some possibility of a cost saving in using the immersion lubricant. There has been very little time to investigate this possibility and we have no reliable information to present.

Summary

1. Phosphate coating has helped make practical the use of true size rod in nut forming, thereby saving two operations, material handling, time, and labor. Conventional lubricants such as lime, sull and stearates failed to produce satisfactory results in this operation.

★ ★ ★

2. Certain special effects and benefits may be realized from phosphate coatings, particularly in forming specialty bolts, screws, and rivets or in other unusual or difficult operations.

★ ★ ★

3. There is strong indication of extensive tool life increase, particularly on fasteners formed with high chrome, high carbon heat treated steel dies. Further work is necessary to determine a similar

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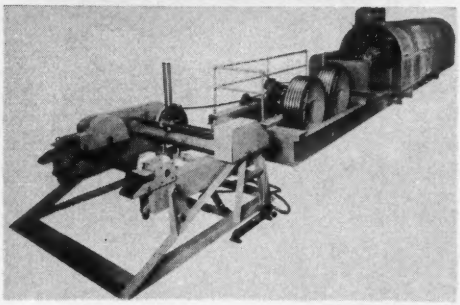

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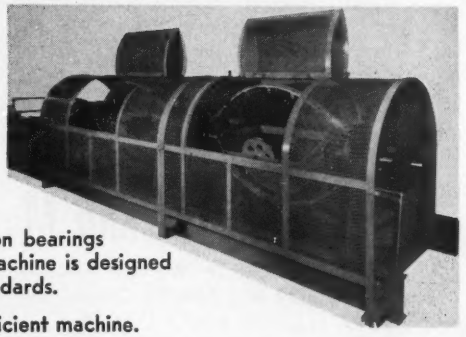

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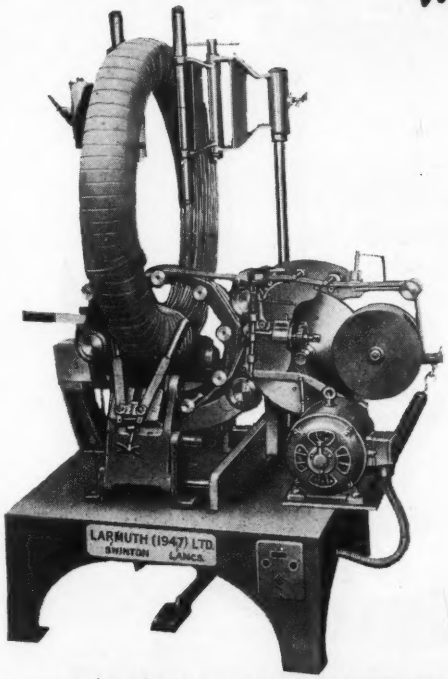

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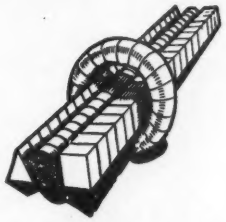

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extension of the life of carbide tools.

★ ★ ★

All of the data here reported and the conclusions reached are based on the use of phosphate coating baths made with Granodraw, one of our products.

★ ★ ★

Our original question "Where is the place for phosphating in fastener forming?" is only incompletely answered. We now know that it surely has a place and that the extent of its use in a plant depends largely on the type of operations conducted in that plant. As fastener manufacturers take advantage of the benefits available from phosphate coatings, its place will become more and more important.

Accelerated Heat Aging of Polyethylene

(*Continued from page* 1489)

laboratory test, on a weatherproof polyethylene composition, which will predict these happenings. ASTM has appointed a task group to study this problem and recommend a test for determing thermal stability or oxidative degradation. The work of this group probably offers the best approach to a solution to this problem.

★ ★ ★

Briefly, we have reviewed the effect on polyethylene of accelerated heat aging. The crystallinity of the polymer increases, reducing the apparent elongation. There is no oxidative degradation of the polyethylene under the test conditions used. Heat aging actually improves the polymer for some applications, such as wire and cable, giving better abrasion resistance and less heat distortion at a given temperature.

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* Du Pont's registered trademark for polyethylene resin.

Recent Developments In Polyethylene Insulating Materials

(*Continued from page* 1500)

dicate that the low pressure polymer has characteristics similar to materials which have been established as being extremely tough and useful on a service basis. There is reason to expect that this polymer would establish a high performance reputation.

★ ★ ★

For purposes of further investigation, it would be well to attempt to translate this body of data into possible end uses for the new polymer. We have seen that this material is an excellent electrical insulator. Its physical properties show it to be a tough material which could be used for both insulating and jacketing applications. Since the new polymer has a better deformation resistance it can in all probability be used in thinner walls. This is desirable for multiconductor assemblies where deformation problems are often encountered. The new polymer will unquestionably make an outstanding supplement to the presently available polymers used for wire and service drop cable covering. It may well expand the potential use of polyethylene as a jacketing material over lead.

★ ★ ★

It must be recognized that some of the properties of the new polymer will be the same as for high pressure polyethylenes. For example, it will have the same burning characteristics. Though studies have not been completed, there is every indication that with the addition of carbon black excellent weathering characteristics will be obtained. As with standard polymers, the oxidation resistance of the low pressure polymer is such that an anti-oxidant will be required. This same property will limit the continuous high temperature performance of the new polymer. The operating temperatures for the new polymer will depend to a certain extent upon the nature of the anti-oxidant employed to stabilize it. However, there is doubt, that there will be vastly improved factors of safety for momentary

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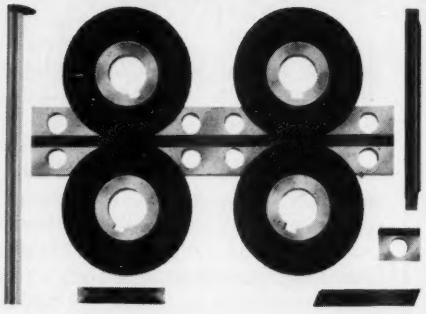

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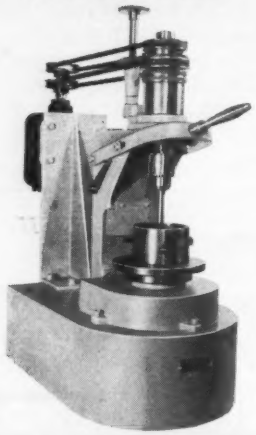

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Wire and Cable Firm Leaving Ansonia

The Ansonia Wire & Cable Company with an annual payroll of about $1,000,000 and a working force of 300, is planning to transfer its operations to an industrial site near Berkeley Airport, R. I., north of Providence.

★ ★ ★

It is expected that the wire and cable company will take possession by March 1st. It has obtained a 20-year lease and will own the plant at its expiration.

★ ★ ★

The company manufactures insulated and jacketed wires and cables for railroads, utilities, radio, telephone and shipboard communications.

Nut Firm to Build New Plant

Harvey Jacobson, President of the **Jacobson Nut Mfg. Corp.,** has announced that ground has been broken for a new plant located on Mark Road, Kenilworth, N. J.

★ ★ ★

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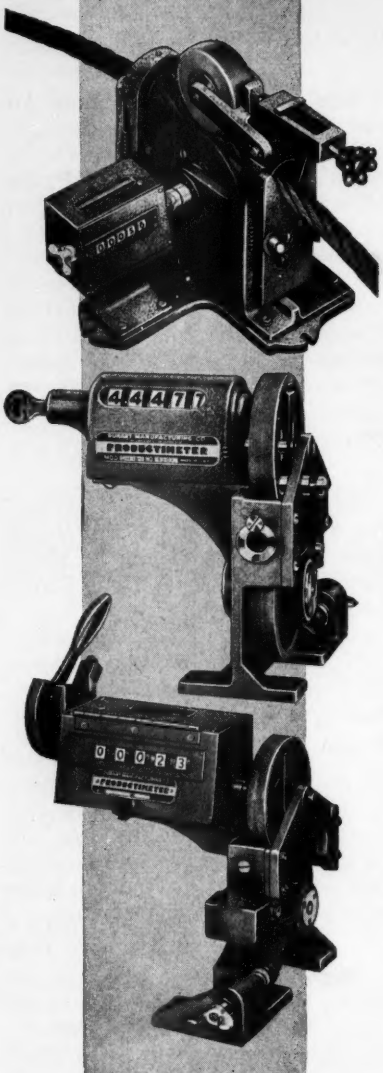

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Called "Densheath 900," the wire consists of a bare copper conductor insulated with an oil and moisture resistant Densheath (polyvinyl chloride) 90° C compound, and slipper compound overall to insure ease of pulling in conduits. The wire is rated at 600V.

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★ ★ ★

Although the wire is dual-rated, current ratings should be based on a maximum of 60° C when it's used as a TW wire in National Electrical Code applications. In locations outside the jurisdiction of the Code, however, the wire can be used to a maximum of 90° C. When used as a machine tool or appliance wire, it carries Underwriters' approval as a 90° C wire.

★ ★ ★

The new wire is available in sizes 14 AWG to 2000 mcm when used as TW; in sizes 14 to 4/0 AWG when used as an appliance wire.

Presents Developments in Color Anodizing of Aluminum

Reynolds Metals' "Technical Advisor" No. 31, just published, presents recent developments in color anodizing aluminum.

★ ★ ★

Colored aluminum, it is pointed out, is made possible by treating the anodized aluminum with new sunfast dyes that do not fade upon continued exposure to sun and

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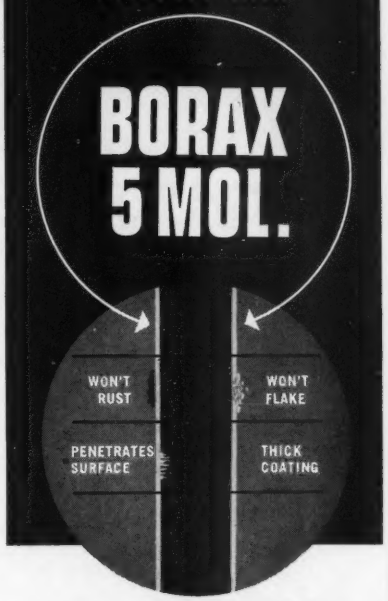

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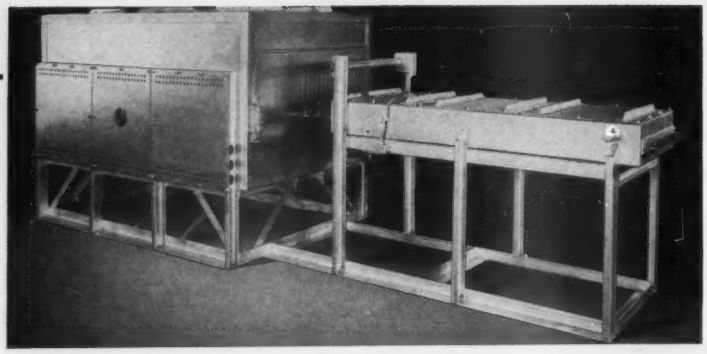

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By New

30 STRAND CONTINUOUS ANNEALER

Maximum brightness is obtained as each strand is passed through individual tube filled with pure hydrogen.

Complete and uniform anneal is obtained by uniform application of heat to all 30 tubes as they pass through hot zone to water cooling zone.

Your request for details on this new 30 Strand Annealer will receive prompt attention.

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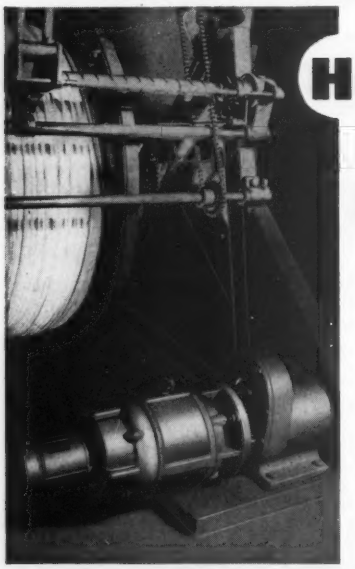

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WINDING ENGINEERED FOR WIRE MILLS

You can profit from Hobbs-Alquist winding Engineering if you wind ferrous or non-ferrous wire for spooling, respooling for further processing, for tension control of winding or for any other purpose! Hobbs-Alquist alone offers a complete line for winders and winding machinery and a complete winding engineering service.

Ask for the new Hobbs-Alquist Winding Engineering brochure . . . it completely describes and illustrates the winders, winding machinery and the engineering service.

Your First Step To Winding Savings !

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weather. These new organic dyes have been developed during the last few years and have proved in actual service to be entirely satisfactory for many applications.

★ ★ ★

The importance of these colored anodic films is that they are part of the metal surface itself, and so are not subject to peeling, shipping and scaling, as are conventional paint coatings.

★ ★ ★

This issue of the **"Technical Advisor"** also includes a question-and-answer section with items on sintered aluminum powder (SAP) and "Hinduminium 100," the Sanford process, the ability of foil to retard the spread of fire, recommendations for solving a severe abrasion-corrosion problem, a new method for laying aluminum pipe at rates up to ten times conventional speeds, aluminum-coated wire and its applications, and a new method of litho-coloring aluminum.

★ ★ ★

Reynolds "Technical Advisor" No. 31 will be sent without charge upon request to **Reynolds Metals Company,** 2500 South Third Street, Louisville 1, Kentucky.

★ ★ ★

New Alundum Tool for Metal Cutting

Norton Company's research has developed an Alundum ceramic metal-cutting tool that has produced startling results, as disclosed by a recent development test program at the Rodman Laboratory of Watertown Arsenal.

★ ★ ★

These Alundum tool bits are entirely in the development stage. Made of aluminum oxide, Norton's Alundum product, they are available only in limited quantities to industry for research and machining studies.

★ ★ ★

One importance of this new tool to industry lies in the abundant supply of ceramic materials. In addition, ceramic cutting tools may have an added advantage of being considerably less expensive than conventional tools.

★ ★ ★

Machining tests at Rodman Laboratory on steel (SAE 1020 and SAE 4140), commercial brass and low alloy cast iron show that the hardness, high temperature strength, and wear-resistance properties of the Alundum cutting tools are superior to metallic tool compositions. By means of heavy, rigid tool holders, ceramic tool characteristics of lower tensile strength at room temperature plus less thermal shock resistance, have been overcome.

★ ★ ★

Because they can be operated at higher speeds, these ceramic tools cut up to three times faster than normal in these tests, required no coolant, and produced excellent surface finish. As more rugged machines with increased power become available, it is expected that even greater superiority will result.

Catalog of Grinding and Lapping Machines

Norton Company has published a new 32 page general catalog of its precision grinding and lapping machines.

★ ★ ★

The catalog contains photographs and specifications of the Norton line of machines which include cylindrical grinders, cam, shape and crankpin grinders, tool and cutter grinders. universal grinders, surface grinders, lapping machines, and special purpose grinders. Also included is a list of firms that represent Norton's Grinding Machine Division in the United States, and a list of Norton's own branch offices.

★ ★ ★

Copies of this booklet may be obtained by writing for Catalog No. 1843, Norton Company, Worcester 6, Mass.

New Quick Estimating Aid for Screw Machine Products Fabricators

Scovill Manufacturing Company, Mill Products Division, Waterbury, Connecticut, has developed an exceptionally easy-to-use table for estimating the weight of Scovill HIGH-SPEED Free-Cutting Brass

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RUST PREVENTATIVES LUBRICANTS

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Music Wire for Industrial Purposes
211 sizes Bright Polished, .0015" to .3437"
45 sizes Bright Tinned, .003" to .125"
Aluminum—Annealed—Belt Lacing—Brass, Soft and Spring—Copper, Bare and Tinned
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Hoskins Chromel "A"—Stainless, Soft and Spring Temper—Tag Wire, 1000
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Wires Straightened and Cut to length—Small Gauges—Small orders our specialty
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WOOD - PLYWOOD - WOOD - METAL

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Save on replacement and maintenance!

RUGGED STEEL HEAVY DUTY PROCESSING REELS

Having trouble with light weight reels failing in heavy duty service? Send us a sketch or print stating the limiting dimensions and service required, we'll be glad to tell you about our facilities for supplying the wire rope and cable industry with special heavy duty processing reels, spools or bobbins. WRITE FOR BULLETIN 52-W.

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DESIGNERS – ENGINEERS – MANUFACTURERS
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all sizes and constructions
of high quality
copper and bronze wire
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BRAIDERS • CABLERS • TAKE-UPS
BUNCHERS • STRANDERS • TAPING MACHINES
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for Telephone • Razor • Hearing Aid Cords
Silver Coated Copper Wire
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Flat for Tinsel Ribbons and Tinsel Garlands.
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washington, pennsylvania

Rod required for screw machine products fabrication. Features of the table are the columns for "pounds per 1,000 pieces per inch" for round, square and hexagon rod in all commonly used diameters from 1/16" to 3-1/2", as well as the figures for "pounds per linear foot." Also given are weight conversion factors for 28 other popular copper-base alloys, making the table applicable to the great bulk of screw machine products fabrication. Copies may be obtained free of charge on request.

Rome Cable Using Non-Returnable Reels

In the interest of better serving the electrical industry, **Rome Cable Corporation** has announced the adoption of non-returnable reels as standard put-up for certain of its wire and cable products.

★ ★ ★

Rome's adoption of a non-returnable type reel is the result of over five years of test program at the University of Maine, as well as trial shipments by the company. The reel is of hard wood and has been found entirely satisfactory and durable. Although intended as an expendable, one-trip package, the new reel has, by test, 80 per cent of the strength of the conventional returnable reel.

★ ★ ★

Introduction of non-returnable reels as standard put-up is an innovation in the wire and cable industry. According to a company spokesman, it represents fruition of part of Rome Cable's long range planning for greater customer service. The non-returnable reels will be shipped without billing and will not be subject to return for credit. This "no deposit — no return" feature offers a number of distinct advantages through minimizing the keeping of reel records and eliminates the gathering and handling of reels for return. As quickly as present inventories are depleted the manufacturer expects that all shipments of applicable cable types and sizes will be made on non-returnable put-up.

★ ★ ★

For the time being, the com-

pany's use of non-returnable reels will be restricted to items of Building Wire, rubber and neoprene power cables and certain Service Cables. Cable items other than those mentioned will continue to be shipped on conventional returnable type reels. It is hoped that experience and further development work will indicate the feasibilty of extending the non-returnable put-up to a wider range of wire and cable types.

P. C. Borax to Use New Mining System

Pacific Cost Borax Co. Division of Borax Consolidated, Limited has announced that it is starting work to convert its present system of mining at Boron, Calif., to open-pit and is constructing new concentrating and refining plants at such minesite.

★ ★ ★

Recent developments in technique and equipment now make possible the recovery of virtually the entire orebody at Boron by open-pit methods. Substantial increases in demand which have occurred since the war and the likelihood of still larger requirements in the reasonable future make this project economically justifiable and, of equal importance, the improved ore recoveries will greatly extend the life of the mine.

★ ★ ★

The new facilities will cost around eighteen million dollars to complete and are expected to be in operation around the second half of 1957.

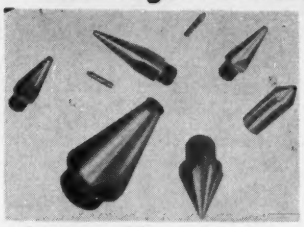
Circular Describes Narrow-Strip Furnace

A new bulletin issued by the **Lee Wilson Engineering Company** 20005 West Lake Road, Cleveland 16, Ohio, describes and illustrates the new narrow strip annealing furnace developed by the company. This is single stack circular bell-type utilizing the Wilson "O" tube, which is said to provide faster heating, faster cooling, extra tonnage and to reduce fuel consumption.

★ ★ ★

For a copy of this bulletin. please write the company.

Get High EXTRUSION PRODUCTION



Some types and sizes of Nozzles.

with CARBIDE NOZZLES

(made for all makes of *Extruders* for electric wire)

One major Electric Wire and Cable concern has produced over 40 MILLION FEET of electric wire with our NOZZLES. It is still in perfect condition and producing daily.

They will save you money!

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We Pay Highest Prices for Used Machinery

URGENTLY NEEDED—
WIRE AND CABLE EQUIPMENT
HIGHEST PRICES PAID

All Machines Reconditioned in Our Own Shop

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THE BETTER YOUR PRODUCT!

Choose *Cortland* GALVANIZED WIRE

Fine products are made from fine-quality materials. That's why so many fabricators and formers select Cortland Brand specialized low carbon wires. Cortland Brand wires are among the finest available . . . made from the best corrosion-resisting, open-hearth steel in Wickwire's own mills. Use them for your products . . . in any of the following types, sizes and finishes.

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SIZE: coils, spools or straightened cut to length.
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various widths and colors wound on reels, cops.

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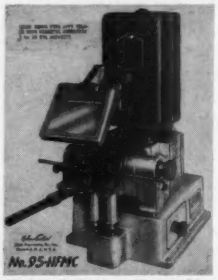
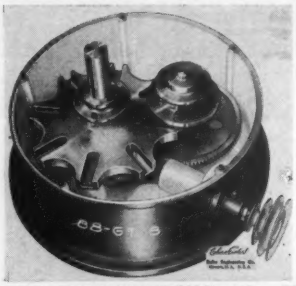
A WELDER FOR EVERY PURPOSE



Eisler Indexing Turntables over 100 different types Geneva Gears-Cams made to your specifications. Write for catalog.



EISLER ENGINEERING CO., INC.
CHARLES EISLER, Jr., Pres
747 South 13th St. Newark 3, N. J.

Carboloy Appoints Syracuse Distributor

A branch office of **Syracuse Supply Co.**, Syracuse, N. Y., was recently designated an authorized distributor by **Carboloy Department of General Electric Company,** Detroit.

★ ★ ★

Located on Curry Road, Schenectady, N. Y., the branch office is headed by **P. B. Scott,** branch manager. The organization will handle Carboloy's line of standard and special carbide metal cutting tools, as well as its diamond grinding wheel dressers.

Anaconda Revises W & C Catalog

Major revisions of the first two sections of **Anaconda Wire & Cable Company's** catalog have been completed and are now being released to customers.

★ ★ ★

Both Section 1, covering "Bare and Coated Wire and Cable", and Section 2 — "Weatherproof Wire and Cable"—have been revised for easier reference and reading, and brought up to date in line with changes in ASTM specifications for copper and aluminum. New ACSR constructions have been added.

★ ★ ★

A ten-page section on overhead line accessories has been incorporated in Section 2 for the first time. The material is a revision of Sections 14-70, -75 and -80 and will continue to appear in Section 14 also.

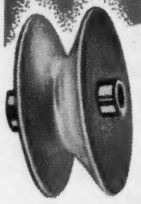
★ ★ ★

The Company announced that Section 23, on wire and cable application, has also been updated and is being released.

Nopco Expects Market Rise for Foams; Stier to Head of Plastics Division

The market for urethane foams should rise shortly from a few hundred thousand pounds a year to one hundred million pounds a year, according to **Ralph Wechsler,** President of the **Nopco Chemical**

Use HEANIUM



the NEW material that withstands hi-speed pressure of wire by the tons

HEANIUM®
IS THE BEST GUIDE . . . TO LOW COSTS.

If guide wear is a problem in your mill . . .
try HEANIUM®

HEANY INDUSTRIAL CERAMIC CORP.
NEW HAVEN 3, CONNECTICUT

CAREW
THE BEST WIRE CUTTER MADE

SIZES
8"
10"
12"
14"

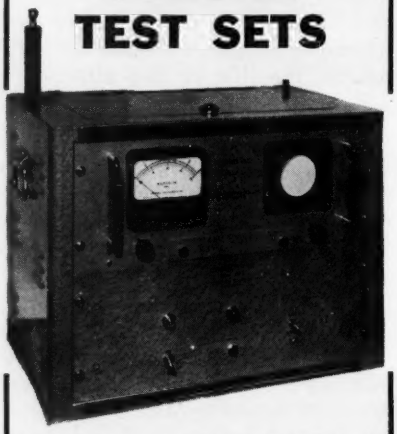
JAWS HARDENED TOOL STEEL

HANDLES DROP FORGED SAE 1035 STEEL

SEE YOUR LOCAL MILL SUPPLY DEALER

M. W. ROBINSON CO., INC.
ROCKFALL, CONN.

CORONA TEST SETS



Meet JAN specs, ASTM, IPCEA Standards for sample or full length cables on reels. Truly non-destructive testing. Available in all sizes from small portable unit to 50 KVA, at any desired voltage—at lowest prices.

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Air Driven
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SPECIFIED DIAMOND CONTENT
UNEXCELLED GRADING
SUPERIOR FORMULATION
LITERATURE ON REQUEST
J. REINHERZ CO.
P. O. BOX 348
MAYWOOD, ILLINOIS

Company, Harrison, N. J.

★ ★ ★

Revealing further details of a huge expansion program into the cellular plastics field, Mr. Wechsler announced the appointment of **George G. Stier** as Assistant Vice President in charge of the Plastics Division, which will open two new plants this year and a third next year. Mr. Stier, who has been with Nopco since 1932, has been Assistant Vice President in charge of the Industrial Marketing Division, which included urethane foam applications.

Special Head Strengthens New Cable Staple

Designed by **E. H. Titchener & Company,** this new cable staple is re-enforced by a special rib pressed into the staple head. This trusslike rib, replacing the conventional flat head construction of round wire cable staples, gives the staple head additional stiffness.

★ ★ ★

The redesigned "Eazy - Drive" staple retains its distinctive holding feature: the staple's barbed legs keep it securely imbedded in wooden beams or joists, and in plaster or cinder blocks.

★ ★ ★

For use with BX or Romex nonmetallic or armored cable, these new staples are available in two sizes—1" inside length and 1¼" inside length. They are boxed in newly designed two-color cartons in quantities of 100, 500, and 2500.

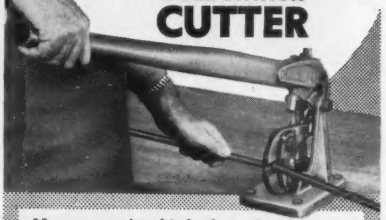
★ ★ ★

For further information, write E. H. Titchener & Company, 67 Clinton Street, Binghamton, New York.

Rea Makes Executive Changes

The Rea Magnet Wire Company, Inc., Ft. Wayne, Indiana, has announced that **Robert L. Whearly,** formerly vice president, was made executive vice president; **David W. Rea,** formerly secretary and director was named vice president and sales manager; **Allen C. Sheldon,** formerly plant manager became vice president—manufacturing.

Increase- HIS METAL CUTTING POTENTIAL
Decrease- YOUR METAL CUTTING COSTS
WITH THE NEW PORTER WORK-STATION CUTTER



No matter what kind of metal you cut — wire, rods, wire rope, cable or any other kind, you can save valuable man hours in your metal cutting operations with the rugged new Porter Work-Station Cutter. Can be fastened to work station welding unit or bolted to a plank and used as a portable cutter. Available in a variety of types of cutter heads for specific requirements. Notched Shear heads for cutting wire rope or cable — Center Cut heads for cutting copper, brass, aluminum, soft steel rods or wire — Center Cut round edge for hard spring wire, etc.
Available in two sizes:
1B cuts wire and cable up to 3/8" diameter.
3B cuts wire and cable up to 9/16" diameter.

Send us sample of metal to be cut and we will advise proper type of jaws required. HKP

WRITE FOR FREE PORTER CUTTER CATALOG
H. K. PORTER, INC. Somerville 43, Mass.

Specify
Warner
BELL-MINE LIME PRODUCTS
Laboratory quality control assures dependability for wire drawing
• Pulverized Quick Lime
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MACHINERY
TO MAKE SINGLE LOOP BALE TIES
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Stop struggling with wire worries. There's a Continental wire to help cut products costs — to add sales appeal. Let us know about your problem . . . Let Continental's helpful wire service work for you.
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PRODUCERS OF Manufacturer's Wire in many sizes, shapes, tempers and finishes, including Galvanized. KOKOTE, Flame-Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright, Lead Coated, and special wire. ALSO, Coated and Uncoated Steel Sheets, Nails, Continental Chain Link Fence, and other products.

A SINCERE WISH
for a
Merry Christmas
and a
Prosperous New Year
is extended to all our customers and friends in the Wire Industry.

We are grateful to you for your continued patronage and shall look forward to serving you further in the New Year.

NATIONAL RESEARCH CO.
25530 LITTLE MACK AVE.
ST. CLAIR SHORES, MICH.

DIAMOND POWDER RECLAIMING SERVICE AND DIAMOND POWDERS.

Strongest Fastener Not Necessarily the Best

It is not enough that a fastener have high tensile strength, point out **Russell, Burdsall & Ward,** fastener experts. It must also have suitable ductility or toughness. Ductility is the ability to be deformed without breaking.

★ ★ ★

As a general rule greater tensile strength means less ductility. Therefore, the correct proportion of tensile strength and ductility must be obtained for each application.

★ ★ ★

A proper balance between tensile strength and ductility is provided by heat treatment. Cold-working increases tensile strength, but it does so at the expense of ductility and it is difficult to control the amount of tensile strength. Therefore, RBW fasteners are made from a) suitably selected steels and b) given appropriate heat treatment, to provide that combination of properties best suited for conditions of service.

Hamilton Watch Making Extra Fine Flat Wire

The Hamilton Watch Company's Allied Products division now has in commercial production extremely fine flat wire, made to very close tolerances.

★ ★ ★

As a by-product of the special process for diamond die drawing of flat wire which Hamilton developed for producing its own hairsprings, the Company specializes in production of flat wire as fine as .0007-inch thick by .003-inch wide. Thicknesses can be held to a tolerance of ±.00001-inch and width to a tolerance of .001-inch. The wire is produced with freedom from twist, so that spiral springs made of it lie flat permitting easy assembly.

★ ★ ★

The conventional process for producing fine flat wire starts with the production of round wire which is then rolled flat. The Hamilton process starts with a thin

"Manufacture and Properties Of Steel Wire"

A new book by Anton Pomp, Dr. Eng. translated from German into English by C. P. Bernhoeft, Dipl. Eng., and published by The Wire Industry, London, Eng. It contains 358 pages of text and sells for $11.80 per copy.

It is the most up-to-date treatise on steel-wire manufacture available and covers the latest developments in wire processing, such as mechanical descaling, increased drawing speeds and lubricants for these high speeds, die shapes and modern testing procedures. The entire range of wire manufacture, from rods to finished products are discussed.

Copies may be ordered through

•

WIRE & WIRE PRODUCTS
453 Main Street, Stamford, Conn.

flat strip which remains flat throughout the process, becoming thinner with each pass through diamond dies of special design. The characteristics of this fine flat wire—its extreme flatness, mirror finish, precise thickness and width, and round edges.

★ ★ ★

This precision flat wire can be produced from most of ferrous and non-ferrous alloys, except some that are difficult to cold work.

★ ★ ★

Hamilton's Allied Products division will cut the wire to precision lengths, form it in desired spring shapes and heat treat the springs to produce desired spring characteristics. It also draws wire from metals furnished by the customer.

Phelps Dodge Moves General Offices to Uptown New York

The Phelps Dodge Corporation has announced that it moved its New York offices to 300 Park Avenue, New York 22, N. Y. on October 15, 1955. The announcement applied also to its refining and wire mill products subsidiaries, the Phelps Dodge Refining Corporation and the Phelps Dodge Copper Products Corporation. The new offices are between 49th and 50th Streets on Park Avenue.

★ ★ ★

The offices of the Phelps Dodge organization have been located in the downtown district continuously since 1834, when the company was a partnership, and for the past 25 years at 40 Wall Street. The downtown area has thus lost the second of the "Big Three" copper producers, leaving only Anaconda, which still is at 25 Broadway.

★ ★ ★

The corporation's new telephone number is PLaza 1-3200.

Warren Wire to Add Rod Storage Facilities

Wilbur C. Rice, vice president of **Warren Wire Company,** has announced that an addition is to be added to the main plant in Pownal, Vt. The new building, of approximately 8,000 square feet, will be used to store copper rod and make space available for an enlarged wire drawing department. Five new fine wire machines and an additional rod machine will be installed. Rod shaving equipment is also being installed to meet the requirements of higher voltage insulations now being required by the electrical industry.

★ ★ ★

Its magnet wire producing capacity is also being increased by 10,000 lbs. a day by the installation of five new ovens. Upon completion of this expansion program the fabricating capacity of the company will be in excess of 10,000 tons of copper per year.

★ ★ ★

Operations at the main plant, as well as at its Plant 3 in Pownal Center, have increased and are now on a seven day basis. At Plant

WAYNE WIRE DRAWING DIES

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Wire Rope Slings

A wall chart, designed to be displayed in a prominent place in industrial plants—on tool cribs, in rigging departments, near hoists or cranes, has been made available by the **Wire Rope Sling Department** of the **American Chain & Cable Company, Inc.,** Bridgeport 2, Conn.

★ ★ ★

This chart, for Acco-Registered wire rope slings, lists diameters and lifting capacities of the Strand-Laid type slings. Measuring 17 by 21 inches and printed in three colors on durable paper stock, the wall chart is edged top and bottom with metal strips, and can be hung by means of an eyelet on the upper strip.

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New Power Cable Catalog

A new four-page folder describing **Anaconda Wire & Cable Company's** Powerduct cables for flexible bus-drop power distribution has been released.

★ ★ ★

The folder gives complete information and tabular data on the Company's Duracord and Densheath type cables, as well as directions for normal installation with overhead bus-duct.

★ ★ ★

As used with bus-duct, the Powerduct cables permit fast, economical installation and relocation of machines. Extensive rewiring is unnecessary. Distribution of power is completely flexible.

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Both of the Anaconda cables are rated at 600 volts and have three conductors with ground wire. The Duracord cable—the only Underwriters approved bus-duct cable—uses rubber insulation and a tough jacket made of heavy, long-fiber cotton woven like a fire hose. In the Densheath cable, conductors are insulated with PVC and the jacket is of the same material.

Spring Design Data Sheets

Basic considerations in designing precision springs are discussed and illustrated in an eight page engineering study published by the **Hunter Spring Co.** Line drawings, graphs and formulas are used to describe various types of springs and spring design criteria.

★ ★ ★

A graphical description of load-deflection characteristics and the eight ways to specify compression and extension springs are presented. Load deflection characteristics, free angle variation and length variation of torsion springs, and the six ways to specify simple, close-wound torsion springs are discussed.

★ ★ ★

Unbound, the eight page, two color data sheets are designed for loose leaf filing. They are available without cost from the Engineering Department, Hunter Spring Company, Lansdale, Pa.

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New Barrel Deburring Compound Announced

Oakite FM 184, a mildly acidic compound for barrel deburring, and derusting, has recently been introduced by **Oakite Products, Inc.,** manufacturers of metal cleaning and finishing materials.

★ ★ ★

The new material was specifically designed by the Oakite laboratories to replace raw acids in barrel operations, where alkaline materials and abrasives are impractical because of time limitations. It is also designed to improve color of steel after alkaline deburring; to remove heat scale from steel; and to brighten brass, either with or without the use of abrasive media.

★ ★ ★

Oakite FM 184 is said to have good foaming properties at the recommended concentrations of 1 to 3 ounces to the gallon of water. It may be added dry to the burnishing barrel.

★ ★ ★

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Further information concerning this new material is available from Oakite Products, Inc. 152-A Rector St., New York 6, N. Y.

Royle Marks 100th Anniversary

John Royle and Sons, Paterson 3, N. J., manufacturers of rubber and plastic extruding and related equipment, have taken note of their 100th birthday in a special issue of The Royle Forum, which has been devoted entirely to the history of the company from its modest beginnings in 1855 down to the present.

★ ★ ★

The story, entitled "Onward, from the Beginning", through illtration and in text, portrays a typical American success saga. Pictures of various buildings occupied by the company as it grew and illustrations of some of the early machines—routers, bevelers, saws, etc., illumine that part of the text devoted to the early years.

★ ★ ★

Rubber begins to enter the picture around 1880, as evidenced by a Royle tuber bearing that date. Although other equipment was made for some years after, the business gradually began to emphasize wire covering and tubing machines. Many illustrations of machines made through the century embellish the text and visualize the growth of a business from the days of simple mechanical contrivances through a highly technological era.

Names Technical Service Man

Claude F. Harr has been named to the Sales Technical Service Department at **L. O. F Glass Fibers Company,** according to an announcement by **J. M. Johns,** Vice President and Director of Sales. He will headquarter at the company's general offices at Toledo.

★ ★ ★

In his new post, Mr. Harr is associated with **Hugh W. Paul,** Sales Technical Service Manager, in providing the company's sales divisions and customers with technical information on its glass fiber products.

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Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDER RECLAIMING—
Danforth, The C. W. Co., Youngstown, Ohio
Industrial Diamond Powders, Inc., Pittsburgh, Pa.
Kay & Warren Co., Brooklyn, N. Y.
Kelly Wire Die Corp., New York, N. Y.
National Research Co., St. Clair Shores, Mich.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DIAMOND TOOLS—
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio
Molina-Straus Diamond Products Co., New York, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Michigan.

DIES—Carbide, Tungsten & Tantalum
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Michigan.

DIES—Cold Heading
Carboloy Dept. of General Electric Co., Detroit
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio
Vascoloy-Ramet Corp., Waukegan, Ill.
Willey's Carbide Tool Co., Detroit, Michigan.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., New Brunswick, N. J.
Cochaud Wire Die Inc., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Wire Die Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIES DIAMOND—Reversible
National Wire Die Co., New York, N. Y.

DIES—Extrusion
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Metal Carbides Corporation, Youngstown, Ohio
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Michigan.

DIES—Eyelet
Eastern Carbide Corp., New Rochelle, N. Y.

DIES—Nail, Nail Cutters, Feeder Blocks, Grippers, etc.
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc, New York, N. Y.
Carboloy Dept. of General Electric Co., Detroit.
Cochaud Wire Die Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Ft. Wayne Wire Die., Inc., Fort Wayne, Ind.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
National Wire Die Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wayne Wire Die Co., Hillside, N. J.

DIES—Special Shapes, Etc.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.

DIES—Swaging
Sjogren Tool and Mach. Co., Inc., Auburn, Mass.

DIES—Tube Drawing
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y
Vascoloy-Ramet Corp., Waukegan, Ill.
Willey's Carbide Tool Co., Detroit, Michigan.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Wire Packaging
Continental Can Company, Van Wert, Ohio

DRUMS & TRAVERSES—For Cable Reels
Entwistle, James L., Co., Providence, R. I.
Hubbard Spool Co., Garrett, Ind.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio

DRYING EQUIPMENT
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

ENGINEERS—Consulting
Lubricants—Hans C. Bick, Inc., Reading, Pa.
Wire Mill—Clarence S. Arms, Worcester, Mass.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILM—Insulating
Standard Film Products Corp., Pawtucket, R. I.

FINISHERS—Flame Proof, for Wire
Carbro Chemical Co., Pawtucket, R. I.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

FURNACES—Galvanizing Equipment
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Drever Company, Bethayres, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., Fairfield, Conn.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

FURNACES—Pot (oil, gas, electric)
Ajax Electric Co., Inc., Philadelphia, Pa.

FURNACES—Resistance Heating, Strand
(See Annealing Machines)

FURNACES—Salt Bath
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

GAUGES—Wire Diameter, Continuous
Industrial Gauges Corporation, West Englewood, N. J.

GALVANIZING EQUIPMENT — (See MACHINERY—Galvanizing Wire)

GRINDERS—Roll
Norton Co., The, Worchester, Mass.

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HARDSURFACING ALLOYS—
(See Alloys—Hardsurfacing)

HOOKS—Pickling & Liming
Lewis Welding and Engineering Corp., The, Bedford, Ohio
Youngstown Welding & Eng'g' Co., Youngstown, Ohio

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INSULATING MATERIALS—
Carbro Chemical Company, Pawtucket, R. I.
Celanese Corporation of America, New York, N. Y.
Chemical Products Co., E. Providence, R. I.
Electronic Rubber Co., Stamford, Conn.
Monsanto Chemical Co., St. Louis, Mo.
Naugatuck Chemical Div., U. S. Rubber Co., New York, N. Y.
Pittsburgh Plate Glass Company, Pittsburgh, Pa.
Plymouth Cordage Company, Plymouth, Mass.
Standard Film Products Corp., Pawtucket, R. I.

INSULATING MATERIALS—Paper (For Electric Wire Cable)
Plymouth Cordage Company, Plymouth, Mass.

KETTLES—Galvanizing
National Annealing Box Co., Washington, Pa.

LACQUERING SYSTEMS — See MACH.—Lacquering Electric Wire

LACQUERS—For Electric Wire
Chemical Products Co., E. Providence, R. I.

LAGGING—Reel
North Anson Reel Co., No. Anson, Me.

LAME—LAHN—
Kassel Export Company, New York, N. Y.
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS — For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Rome Soap Mfg. Co., Rome, N. Y.
Standard Industrial Compounds Co., Chicago.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.
Ironsides Co., The, Columbus, Ohio

LUBRICANTS—for Metal Cutting, etc.
Ironsides Co., The, Columbus, Ohio

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Bending Wire
Eisler Engineering Co., Newark, N. J.

MACHINERY—Bobbin Winders
Mummert-Dixon Company, Hanover, Pa.
Wire Equipment Mfg. Co., Trenton, N. J.

MACHINERY—Braiding
New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Providence, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Haskell-Dawes Macnine Co. Philadelphia, Pa.
New England Butt Co., Providence, R. I.
New York Engineering Co., Yonkers, N. Y.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Machinery—Winding Wire)

MACHINERY—Centerless Grinding
Schumag Schumacher Metallwerke, Aachen, Germany.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., Bridgeport, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Closing Rope
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Cold Heading
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
National Mach'y Exch. (Used), New York.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Wells, Frank L., Co., Kenosha, Wis.

MACHINERY—Diameter Testing Continuous
Standard Electronic Research, New York, New York.

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Herborn, Germany.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Carboloy Dept. General Electric Co., Detroit, Mich.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Firth Sterling, Inc., Pittsburgh, Pa.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Rockwell Co., W. S., Fairfield, Conn.

MACHINERY—Extruding
Davis-Standard Sales Corp., Mystic, Conn.
Entwistle, James L., Company, Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.

MACHINERY—Flat Wire
Fenn Manufacturing Co., Newington, Conn.
Mettler Machine Tool, Inc., New Haven, Conn.
Rockwell, W. S., Company, Fairfield, Conn.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming Wire
Baird Machine Co., Stratford, Conn.
Nilson, A. H., Machine Co., Bridgeport, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Davis-Standard Sales Corp., Mystic, Conn.
Fidelity Machine Co., Inc., Philadelphia, Pa.
Litzler, C. A., Co., Inc., Cleveland, Ohio.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia.
Cook Mfg. Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, O.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Mummert-Dixon Co., Hanover, Pa.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Wire & Cable
Davis Electric Company, Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, James L., Company, Providence, R. I.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Baird Machine Co., The Stratford, Conn.
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.
Seybold Transworld Exporters, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Packaging Wire
Coulter & McKenzie Machine Co., Bridgeport, Conn.

MACHINERY—Pickling
Lewis Welding & Engineering Corp., The, Bedford, Ohio
Youngstown Welding & Eng'g Co., Youngstown, Ohio.

MACHINERY—Pin Making
Baird Machine Co., The, Stratford, Conn.

MACHINERY—Pointing
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury Conn.

MACHINERY—Pumps for Molten Metal
Wire Equipment Mfg. Co., Trenton, N. J.

MACHINERY—Re-Spooling
Boyd & Sons Manufacturing Corp., Philadelphia, Pa.
Davis Electric Company, Wallingford, Conn.
Emory, Robert J., Co., Newark, N. J.
Mummert-Dixon Co., Hanover, Pa.
National Mach'y Exch. (Used), New York.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Wire Equipment Mfg. Co., Trenton, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Rod Mill
Fenn Manufacturing Co., Newington, Conn.
Morgan Construction Co., Worcester, Mass.
Schumag Schumacher Metallwerke, Aachen, Germany

MACHINERY—Rolling Mill
Fenn Manufacturing Co., Newington, Conn.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Sales Corp., Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Royle, John & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Spark Testing
Davis Electric Company, Wallingford, Conn.
Entwistle, James L., Company, Providence, R. I.
Peschel Electronics, Inc., New Rochelle, N. Y.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Staple
Nilson, A. H. Machine Co., Bridgeport, Conn.
Seybold Transworld Exporters, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Straightening & Cutting
Continental Fdy & Machine Co., Pittsburgh, Pa.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Stranding
Haskell-Dawes Machine Co., Philadelphia, Pa.
Milton Machine Works, Inc., Milton, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Swaging
Fenn Manufacturing Co., Newington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Company, Wallingford, Conn.
Davis-Standard Sales Corp., Mystic, Conn.
Entwistle, James L., Company, Providence, R. I.
Fenn Manufacturing Co., Newington, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio.
New York Engineering Co., Yonkers, N. Y.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.
Wire Equipment Mfg. Co., Trenton, N. J.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Testing Magnet Wire Coatings for Pin Holes
Peschel Electronics, Inc., New Rochelle, N. Y.

MACHINERY—Testing, Physical
Scott Testers, Inc., Providence, R. I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Turks Head
Fenn Manufacturing Co., Newington, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Cook Manufacturing Co., The, Paterson, N. J.
Davis Electric Company, Wallingford, Conn.
Edmands Company, The, Providence, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot)

MACHINERY—Winding Wire
Emory, Robert J., Newark, N. J.
Entwistle, James L., Company, Providence, R. I.
Fenn Manufacturing Co., Newington, Conn.
Mummert-Dixon Co., Hanover, Pa.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.
Wire Equipment Mfg. Co., Trenton, N. J.

MACHINERY—Wire Drawing
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Fenn Manufacturing Co., Newington, Conn.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

Herborn, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
Morgardshammers Mek Verstads AB, Morgardshammer, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Schumag Schumacher Metallwerke, Aachen, Germany
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Forming
Baird Machine Co., The, Stratford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope
Milton Machine Works, Inc., Milton, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Co., Boston, Mass.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

NAIL TOOLING—Tungsten Carbide
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting
Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling
American Insulating Mach'y Co., Phila., Pa.
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Rockwell Co., W. S., Fairfield, Conn.

OVENS—Rod Bakers
Carl-Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio.

PAINT BONDING CHEMICALS—
American Chemical Paint Co., Ambler, Pa.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PANS—Spelter, Galvanizing, Lead
National Annealing Box Co., Washington, Pa.

PAPER—Creped Wrapping
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Terkelsen Machine Co., Boston, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Terkelsen Machine Co., Boston, Mass.

PAPER—Insulating
Plymouth Cordage Company, Plymouth, Mass.

PATENT ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D. C.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PICKLING—Hooks, etc. Acid Resisting
Lewis Welding and Engineering Corp., The, Bedford, Ohio
Youngstown Welding & Eng'g Co., Youngstown, Ohio

PICKLING TANK LININGS—
Chemsteel Construction Co., Inc., Pittsburgh, Pa.
Haveg Corp., Newark, Del.

PIPES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

PLASTICIZERS—
Celanese Corporation of America, New York, N. Y.
Monsanto Chemical Co., St. Louis, Mo.
Naugatuck Chemical Div., U. S. Rubber Co., New York, N. Y.

PLASTICS—for Wire Insulation
Carbro Chemical Co., Pawtucket, R. I.
Celanese Corporation of America, New York, N. Y.
Electronic Rubber Co., Stamford, Conn.
Monsanto Chemical Co., St. Louis, Mo.
Naugatuck Chemical Div., U. S. Rubber Co., New York, N. Y.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

POTS—Wire Tinning
National Annealing Box Co., Washington, Pa.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

PUMPS—Molten Metal
Fisher Associates, New York, N. Y.

REEL AND TENSION STANDS—
Davis Electric Company, Wallingford, Conn.
Industrial Ovens, Inc., Cleveland, Ohio.
New York Engineering Co., Yonkers, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Garrett, Ind.
Milton Machine Works, Inc., Milton, Pa.
Muncy Valley Industries, Inc., Muncy Valley, Pa.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Garrett, Ind.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Muncy Valley Industries, Inc., Muncy Valley, Pa.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio

REELS—Metal Bound
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., Wm., Westport, Mass.
North Anson Reel Co., No. Anson, Me.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REELS—Plywood
Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., Wm., Westport, Mass.
Nelson Company, The, Baltimore, Md.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L. Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Garrett, Ind.
Mason Can Company, East Providence, R. I.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
Mason Can Company, East Providence, R. I.
McCaskie, Inc., Wm., Westport, Mass.
Mettler Machine Tool, Inc., New Haven, Conn.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., Yonkers, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
North Anson Reel Co., No. Anson, Me.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wood
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garret, Ind.
Muncy Valley Industries, Inc., Muncy Valley, Pa.
Nelson Company, The, Baltimore, Md.
North Anson Reel Co., No. Anson, Me.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

RETORTS—Annealing
National Annealing Box Co., Washington, Pa.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Crucible Steel Co. of America, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Wire—Non-Ferrous
Chase Brass & Copper Co., Waterbury, Conn.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Titan Metal Manufacturing Co., Bellefonte, Pa.

RODS—Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.

RUST PROOF COMPOUNDS—
(See COMPOUNDS—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—Rust Preventing)

SATURANTS—Cable
Carbro Chemical Company, Pawtucket, R. I.

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio
New York Engineering Co., Yonkers, N. Y.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SPOOLS—(See Reels & Spools)

SPOOLS—Stamped Metal for Retail Wire Sales
Clark, J. L. Mfg. Co., Rockford, Ill.
Mason Can Co., East Providence, R. I.

STAMPINGS—Steel
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

TANKS—Compound
National Annealing Box Co., Washington, Pa.
New York Engineering Co., Yonkers, N. Y.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling and Plating
Chemsteel Construction Co., Inc., Pittsburgh, Pa.
National Annealing Box Co., Washington, Pa.

TESTERS — INSULATION
(See MACHINERY—Spark Testers)

TESTING EQUIPMENT
(See MACHINERY Testing, Physical and Diameter Testing)

TINSEL—Electric Conductor
Kassel Export Company, New York, N. Y.
Montgomery Co., The, Windsor Locks, Conn.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper, Silver and False Gold Coated, etc.
(See TINSEL—Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.
Wire Equipment Mfg. Co., Trenton, N. J.

TOOLS—Wire Cutting
Porter, H. K. Inc., Somerville, Mass.

TOOLS—Spring Forming, Carbide
Crafts, Arthur A., Company, Inc., Boston, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRANSMISSIONS—Variable speed (See Machy—Power Transmission)

TRAVERSES & DRUMS—For Reels
(See Drums & Traversers)

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

VALVES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES & LACQUERS—for Electric Wire
Carbro Chemical Co., Pawtucket, R. I.
Chemical Products Co., E. Providence, R. I.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.

WIRE—Aluminum
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Scovill Mfg. Co., Waterbury, Conn.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brass and Bronze
Chase Brass & Copper Co., Waterbury, Conn.
Jury's Wire Products, Inc., Bloomfield, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Spencer Wire Corp., Union, N. J.
Titan Metal Manufacturing Co., Bellefonte, Pa.

WIRE—Brush
Spencer Wire Corp., Union, N. J.

WIRE—Bunched & Stranded, Copper
Camden Wire Co., Camden, N. Y.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Camden Wire Co., Camden, N. Y.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind
Crucible Steel Co. of America, Pittsburgh, Pa.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Titan Metal Manufacturing Co., Bellefonte, Pa.
Wickwire Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Copper
Camden Wire Co., Inc., Camden, N. Y.
Chase Brass & Copper Co., Waterbury, Conn.
Jury's Wire Products, Inc., Bloomfield, N. J.
Spencer Wire Corp., Union, N. J.

WIRE—For Electrical Conductors
Camden Wire Co., Camden, N. Y.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.

WIRE—Flat, Fine
Kassel Export Co., New York, N. Y.
Montgomery Co., The, Windsor Locks, Conn.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
National Standard Company, Niles, Mich.
Roebling's, John A. Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Magnet
Kassel Export Company, New York, N. Y.

WIRE—Manufacturers
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark, N. J.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Spencer Wire Corp., Union, N. J.
Titan Metal Manufacturing Co., Bellefonte, Pa.
U. S. Steel Corp., N. Y., N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Molybdenum
Kassel Export Company, New York, N. Y.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Kassel Export Co., New York, N. Y.
Malin & Co., The, Cleveland, Ohio
Spencer Wire Corp., Union, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Chase Brass & Copper Co., Waterbury, Conn.
Malin & Co., The, Cleveland, Ohio
Titan Metal Manufacturing Co., Bellefonte, Pa.

WIRE—Oil Tempered
Crucible Steel Co. of America, Pittsburgh, Pa.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.

WIRE—Silver Plated Copper
Camden Wire Co., Camden, N. Y.
Kassel Export Co., New York, N. Y.

WIRE—Special Shapes
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
Titan Metal Manufacturing Co., Bellefonte, Pa.

WIRE—Spring
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Crucible Steel Co. of America, Pittsburgh, Pa.
Firth Sterling, Inc., Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE—Steel—Also Coppered and Galvanized Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jury's Wire Products, Inc., Bloomfield, N. J.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Spencer Wire Corp., Union, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O

WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Tinned Copper
Camden Wire Co., Camden, N. Y.
Jury's Wire Products, Inc., Bloomfield, N. J.
Kassel Export Co., New York, N. Y.
Spencer Wire Corporation, Union, New Jersey

WIRE—Tungsten
Kassel Export Company, New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARNS & TAPES—Insulating
Celanese Corporation of America, New York, N. Y.
Pittsburgh Plate Glass Company, Pittsburgh, Pa.
Standard Film Products Corp., Pawtucket, R. I.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

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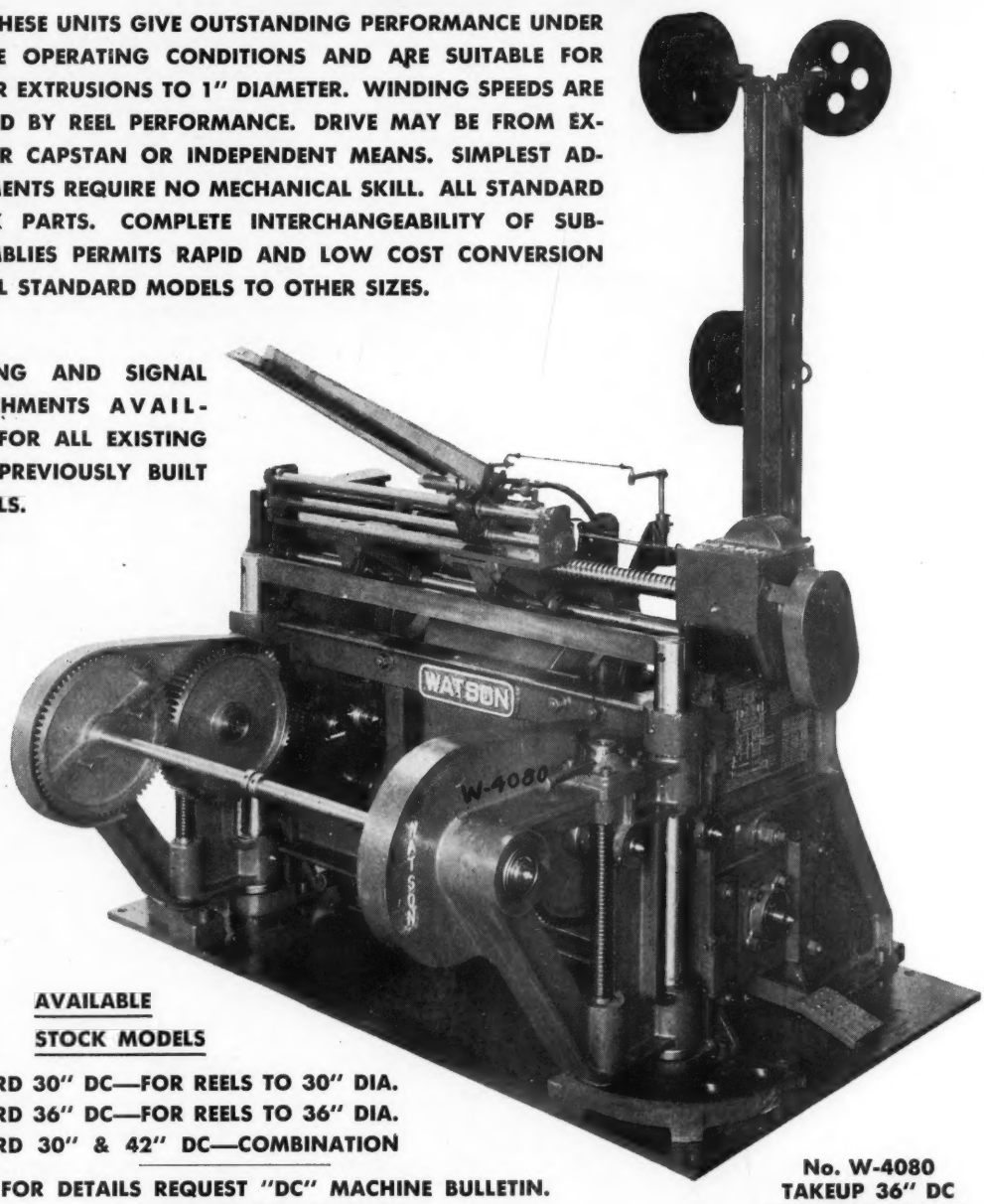

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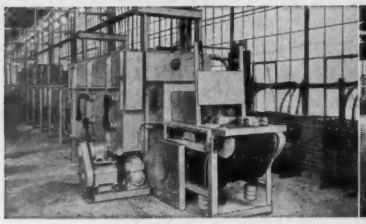

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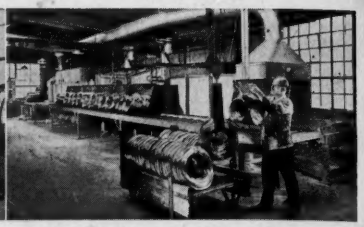

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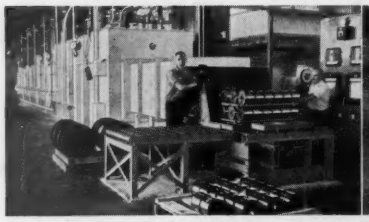

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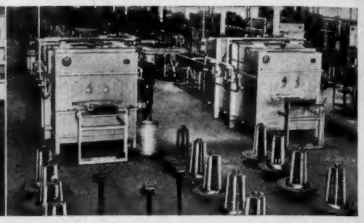

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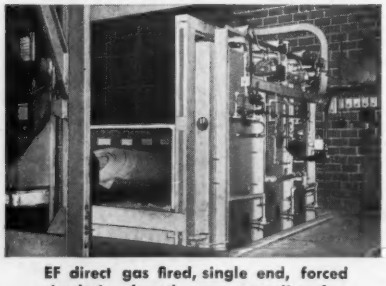
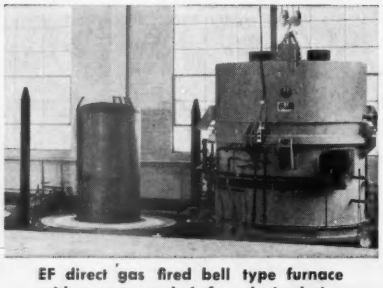
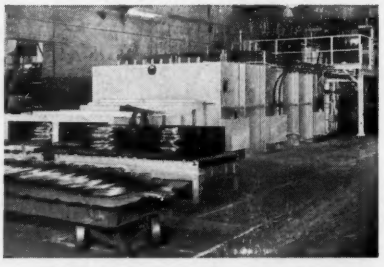


EF direct gas fired, single end, forced circulation hearth type annealing furnace with gantry crane for handling large coils of cupro nickel wire and brass rod.



EF direct gas fired bell type furnace with retorts and 4 forced circulation bases, used for bright annealing both ferrous and non-ferrous flat coiled wire.



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